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THE MARKET FOR HIGHER DEGREE HOLDERS AND THE GRADUATE EDUCATION SYSTEM IN CANADA

by

DENIS ANTHONY O'MALLEY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled THE MARKET FOR HIGHER DEGREE HOLDERS AND THE GRADUATE EDUCATION SYSTEM IN CANADA

submitted by DENIS ANTHONY O'MALLEY

in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

A Buse
Supervisor

E J Hamm

[illegible]

John D Lohnes

Dave Quinn
External Examiner

Date Sept. 4, 1975

ABSTRACT

This thesis seeks to explain surpluses of higher degree holders in Canada by examining the relationships between graduate education and the labour market. The literature on shortages and surpluses in labour markets is reviewed and some recent analyses of the situation in the early 1970's are discussed. Available data on the labour market for higher degree holders in Canada are reviewed and a test for surplus is applied. The results confirm that surpluses of new doctorate and master's degree holders had emerged in Canada by 1972. There have been episodes of surplus and shortage at least since 1910 in Canada. An aggregate production framework is used to organize the available data on higher education in Canada. Graduate students, teaching staff and capital are postulated to be substitutable net inputs in producing educational resources as measured by undergraduate enrolment. This analysis suggests that, over time, more of these inputs have been used to service each undergraduate. Governments accounted for more than 70% of university operating revenues by 1970. Graduate students have been receiving payments from universities which exceed all but the foregone income costs of attending. It is suggested that these payments are factor rewards. A short run model of the relationships between the market for new doctorates and the market for graduate students is constructed. The behaviour of universities is assumed to be motivated by a desire to maximize their output of scholarly research from residual

resources after meeting educational requirements. The motivation of universities is related to market adjustment speeds as well as to structural parameters. Depending upon the signs of the partial derivatives of the excess demands with respect to real graduate stipends and real salaries of new doctorates the model approaches equilibrium directly or through a series of damped cycles. Damped cycles associated with less than instantaneous adjustment speeds are capable of providing a rationalization of events. Inflexible adjustment can also explain the observed situation.

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INTRODUCTION

The Problem

It is now a common observation that sometime in the late 1960's and early 1970's, job-seeking higher degree holders in Canada began to find that not all of them could get the jobs they had expected to get. Those holding degrees in some subjects may have discovered their predicament before others, but very few have escaped it entirely.

Several arguments have been advanced to explain how this situation has been brought about by the behaviour of one or the other of the following: the students, who are supposed to have unreasonable expectations; the university faculties, who are supposed to train too narrowly and build empires; industry, which is supposed to hire too few Ph.D.'s; and society, which is supposed to entice students into advanced study and then reject them. These villains are aided and abetted by the government which is either guilty of trying to solve a short run problem by long run policy or vice versa.[1]

There have also been several attempts to collect relevant data whereby the real gravity of the problem might be assessed.[2] These attempts have, in general, failed to provide an analytical framework in which the elements of

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[1] See Marjaleena Repo, I'm a Ph.D.; Who needs the Ph.D. (Toronto: University of Toronto Graduate Students' Union, 1970), and Ontario Council on Graduate Studies, Survey of Employment of Ontario Ph.D. Graduates: 1964-69, Toronto: Ontario Council on Graduate Studies, (mimeographed) for some remarkable contradictions.

[2] Of these the work by Frank Kelly, Prospects for Scientists and Engineers in Canada, Background study for the Science Council of Canada. Special Study No. 20, March, 1971 (Ottawa: Information Canada, 1971), stands out.

the problem might be organized and their connections studied.[3] Perhaps the most obvious symptom of the lack of any complete analytical framework is the disagreement on the scale of the problem. For instance, some discussants define temporary post-doctoral fellowships as employment and exclude these from their measure of surplus. Others suggest that only university teaching is adequate employment and almost anything else is part of the surplus, because all other employment would otherwise be filled by less qualified personnel.[4] Others have denied the existence of a problem, calling it an opportunity.[5]

It is therefore of importance to explain, at the outset, why such a state of affairs can be considered important, and in particular, why an economist might consider it important.

The studies mentioned above have concerned themselves with the well being of students, of university communities, and of the scientific and engineering community in Canada. A common theme has been the fear that the resources devoted to higher education would be reduced because education is failing to produce the social and individual benefits which have been claimed to flow from it.

However, to consider only the well being of a particular group or

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[3]Some discussion has proceeded along political lines, but has concentrated on either the irrationality of interference or the oppression of some group by another. For example Repo suggests that...."One cannot help but get the impression that there is a conspiracy of silence amongst the agencies involved ...", in discussing the lack of information available to students. I'm a Ph.D.: Who Needs the Ph.D.? p. 2.

[4]Compare for instance the approaches of Repo, I'm a Ph.D., and the Ontario Council on Graduate Studies, Survey of Employment of Ontario Ph.D. Graduates: 1964-69.

[5]Proceedings of the Senate Special Committee on Science Policy, "Remarks of Dr. William George Schneider." 28th Parliament, 1st Session, Wednesday, October 23, 1968, Proceedings, No. 3, pp. 40-41. See also George Lermer, "The Market for University Graduates in the 1970's", Waterloo Economic Series No. 47, Department of Economics, University of Waterloo, October 1971, mimeographed.

groups of individuals ignores the implications for the community as a whole. Surely society may ask that public expenditures be made according to criteria which are consistently applied across all claims on the national budget. All Canadians suffer a net decline in welfare, if public resources are not allocated so as to provide the same or greater marginal social benefits than the marginal private benefit which would be forthcoming from those resources if allocated by the private individuals from whom they were levied. In Canada, university departments have made resource allocation decisions with regard to staffing and graduate admissions subject to competition from similar departments elsewhere and to constraints imposed by Provincial governments. Their funding has come from Federal and Provincial government sources.

The devotion of large amounts of resources to the training of specialists who either refuse to work in Canada or cannot be employed in Canada is likely to be folly. Students in some fields of study are paid allowances which cover all of their direct costs while no income is available to students in alternative fields. An outstanding example is the honours science graduate who is eligible to enter medicine. Support for medical students is negligible compared to support for graduate students in science. Similarly professions such as law can claim that student support for their students is inadequate vis-a-vis that available in areas where eventual employment is far less certain. Some universities have paid graduate students removal expenses or travel allowances as well as stipends for the duration of their studies.

Higher degree holders who discover that they cannot be employed in their field of choice can at least b e said to suffer unnecessary anxiety if such a situation could be avoided. Higher degree holders who already hold jobs may also fear that their real incomes are threatened by new graduates desperately offering their services at lower money wage rates. The spectre of taxi-driving

Ph.D.'s is both a waste of resources and a threat to the security of employed Ph.D.'s and those employed with less educational qualification.

Apart from the social and private problems which unemployed higher degree holders raise, a more fundamental question arises. That is: Has the present state of affairs arisen because of the perturbation of a system which will restore itself to an equilibrium in which these various individuals will again have their expectations met by events? Or has the system itself been changed so that, unless steps are now taken, equilibrium will not be restored without a substantial restructuring of the educational system?

Aims of the Thesis

This thesis is about equilibrium or the lack of it, in aggregate, in the market for higher degree holders in Canada. It investigates the structure by which the current allocation is brought about and the possibilities for future adjustment. In order to fulfil this aim it undertakes the following tasks:

To review critically the available literature analysing and explaining shortages and surpluses in labour markets and to apply it, where possible, to the Canadian case;

To review and consolidate available Canadian data and to use them and other sources to describe and appraise the aggregate development of graduate education in Canada;

To specify an aggregative, short-run, micro-economic model of the market for higher degree holders in Canada with special reference to its relationship with graduate education.

To examine the dynamic behaviour of this model.

Finally, in view of the results obtained, a brief discussion of the implications for policy and for further study is undertaken.

The chapters follow the order of presentation of these aims.

CHAPTER 1

SHORTAGES AND SURPLUSES

This chapter presents a review and critique of the literature on shortages and surpluses in labour markets. One of the models is applied to data on higher degree holders in Canada.

Models of "Surpluses" and "Shortages"

Criteria. In discussing models of 'surplus' and 'shortage' it is helpful to bear in mind a number of criteria for a satisfactory model. An economist, first of all, wishes to deal with an economic 'shortage' or 'surplus', that is a 'shortage' or 'surplus' defined for quantities demanded or supplied at a certain price. Thus an evaluation of quantities desired or produced as judged by some public or private goal such as need, considered independent of price, is not an economic shortage. A second criterion, proposed with a view to the current situation, is that the model proposed be capable of producing either a 'shortage' or a 'surplus' under some conditions. In an empirical study, an important criterion is that of operational usefulness: the model must provide for measurement, at least conceptually and ideally be within the scope of available data. This criterion also involves the requirement for an operational definition of the market.

The requirement of operational usefulness is a very stringent one. It brings forward the problem of a clear empirical definition of the market. In this study the market under consideration is the market for higher degree holders. Higher degree holders are products of graduate study in universities. While the supply or producers' side of this market is made clear by the definition, the demand side cannot at the same time be limited to certain 'suitable' employers. Since both universities and taxicab companies have from time to time paid the salaries of higher degree holders, both must be considered as members of the

demand or purchasers' side of the market for higher degree holders.

This raises the additional problem of defining a 'surplus' or 'shortage' in two stages: in a well defined market of a single occupation, and in the broader market of all occupations.

In the market for higher degree holders, defined to include all possible pursuits of higher degree holders, including leisure, no 'surplus' can exist unless general unemployment prevails. It is necessary to limit the range of pursuits, or employers, in some way. This can be done by setting some minimum acceptable income, and/or by specifying some other qualitative criterion which the pursuit must meet: for example, scientists should be employed in scientific pursuits, or higher degree holders should be in receipt of incomes for current production. When, as in this case, considerable social resources have been devoted to the training and preparation of the individual, then the range of pursuits considered desirable is limited to those which provide for the efficiency of the social investment.

Operationalism also requires that the model indicate how measured 'surpluses' or 'shortages' can be reduced and may therefore be interpreted as requiring the inclusion of the market adjustment mechanism under consideration.

This section has specified some problems for which models of 'surplus' and 'shortage' should provide if they are to be useful as a means of analysing the problem at hand. The resulting criteria may be summarized as the properties of a desirable model for the current purposes. These properties are that the model be (1) economic, (2) capable of representing shortage or surplus, and (3) operational.

Some Models of 'Shortages'

There are two well known definitions and explanations of a 'shortage' due to Blank and Stigler and to Arrow and Capron.

Blank and Stigler's Model

David M. Blank and George J. Stigler state that a shortage "exists when the number of workers available (the supply) increases less rapidly than the number demanded at the salaries paid in the recent past. Then salaries will rise, and activities which once were performed by (say) engineers must now be performed by a class of workers who are less well trained and less expensive."[1]

There appears to be some confusion regarding the use of relative or nominal wages in the Blank and Stigler definition. Donald E. Yett[2] appends to the Blank and Stigler definition the requirement that salaries rise "relative to those for other occupations"[3] and then devotes a footnote to pointing out that relative changes may be reversed depending upon the price elasticities of the demand and supply functions for the particular and the standard occupations.[4] Blank and Stigler apply their definition using salaries relative to those for other occupations. The definition including relative salaries implies that the base period may be chosen arbitrarily, making any results somewhat suspect.[5]

The Blank and Stigler definition (as distinct from their application) defines a certain relationship between successive partial equilibrium positions as evidence of 'shortage'. This relationship may be alternatively stated as

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[1]David M. Blank and George J. Stigler, The Demand and Supply of Scientific Personnel, General Series, No. 62 (New York: National Bureau of Economic Research, Inc., 1957), p. 24, emphasis in original. Note that the less well trained and the less expensive may not always coincide.

[2]Donald E. Yett, "The Chronic 'Shortage' of Nurses: A Public Policy Dilemma" in Empirical Studies in Health Economics: Proceedings of the Second Conference on the Economics of Health, ed. by Herbert E. Klarman with assistance of Helen H. Jaszi (Baltimore: Johns Hopkins Press, 1970) pp. 357-389.

[3]Ibid. p. 359

[4]Ibid. p. 359, note.

[5]See Mary Jean Bowman, "Educational Shortage and Excess," Canadian Journal of Economics and Political Science, XXIX, No. 4, p. 452.

'successive equilibria occur at higher wages than those established by their predecessor'. What relationship would exist in a "surplus"?

In Figure 1.1 consider the alternative locations of a new equilibrium relative to the old equilibrium at 0. Intersection of demand and supply schedules at a salary which is above the recent salary level implies positive excess demand. Intersections below recent salary levels indicate negative excess demand.

A 'surplus' therefore could be defined as successive equilibria occurring at declining wages. If wages are constant then the market is in equilibrium. These three situations are mutually exclusive and exhaust the available alterna-

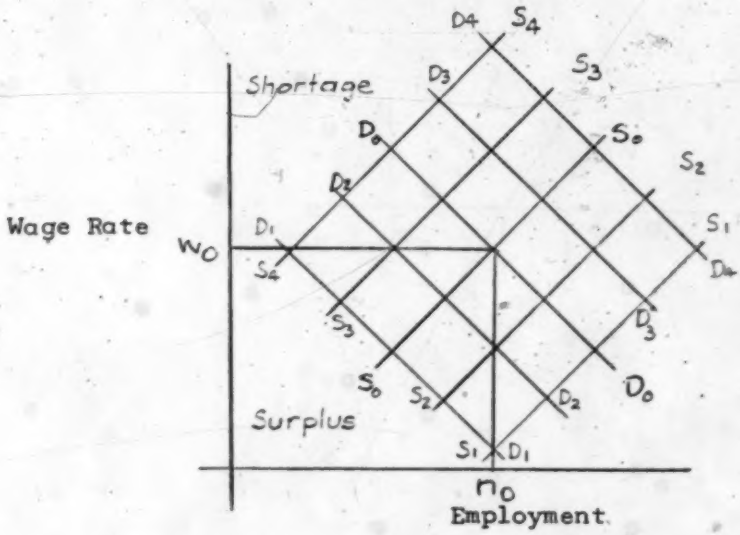

Fig. 1.1 Blank and Stigler's model of shortage and surplus

tives. This definition can handle both 'surplus' and 'shortage'.

It should be emphasized that without knowledge of the demand and supply functions the quantitative significance of a Blank and Stigler shortage cannot be estimated. Their definition implicitly assumes that all observed values of numbers and salaries are equilibrium values, taking the comparative static view that '.... one knows only the historically recorded series of intersection points of

the two (demand and supply) curves."[6] It is suggested that the market adjustment mechanism implied in this definition adjusts price upwards in response to positive excess demand. This instantaneous adjustment fails to occur if the market is not free or if salaries are regulated, in which case non-equilibrium values could be observed.[7]

If shortages or surpluses are disequilibrium situations then the test suggested by Blank and Stigler can still be applied provided an additional premise is accepted. This premise states that relative wages rise if and only if excess demand is positive and fall if and only if excess demand is negative. Blank and Stigler state:

> A second meaning of shortage is that the quantity of the labor services in question that is demanded is greater than the quantity supplied at the prevailing wage. In such a circumstance the wage normally rises, causing the quantity demanded to shrink and the quantity supplied to expand. The shortage vanishes as soon as the market can adjust to the excess demand.[8]

The second sentence contains the premise.

The definition of 'shortage' used by Blank and Stigler does not explain the existence of positive excess demand at ruling prices - it rejects the possibility of observing such a situation in a free market - and instead suggests that 'shortages' are ex ante phenomena which would appear were the 'auctioneer' to ask for bids at the last prevailing equilibrium price, and are indicated ex post by the new equilibrium occurring at higher prices than the last. It is open to question whether this can seriously be considered a 'shortage', although the definition does lead to an analysis of the determinants of supply and demand.

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[6] Blank and Stigler, The Demand and Supply of Scientific Personnel, p. 20.

[7] Ibid. p. 24 [8] Ibid. p. 23.

It is worth noting in passing that in monopsonistic and oligopsonistic labour markets shortages in the labour market will be reported at equilibrium as long as the supply of labour is upward sloping.[9] These employers are willing to employ more labour provided the marginal cost of additional labour is lower than at present. They want a more elastic supply curve of labour and may report vacancies in an attempt to achieve this, either by widening the sources of applicants or by obtaining the co-operation of training institutions and government.[10] This makes difficult direct measurement of shortages due to disequilibrium in these markets.

Yett also criticizes the Blank and Stigler definition for ambiguity in the 'short run'.[11] In Yett's terminology the 'short run' is a period too short for adjustments to the output of training institutions. At this point Yett follows the argument suggested by W. Lee Hansen.[12] A short-run rise in wages in a particular occupation will be followed in the long-run by a fall in wages when the training institution's change in output reaches the market. Thus a 'long-run shortage' can consist of a 'short-run shortage' followed by a 'short-run surplus'. It should not be surprising that comparative statics results should depend upon which parameters have changed and which short-run equilibria are compared. This argument is depicted in Figure 1.2 shown on the following page.

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[9] G. C. Archibald, "The Factor Gap and the Level of Wages," Economic Record, XXX (November, 1954), pp. 188-189.

[10] John G. Myers, "Job Vacancies in the Firm and the Labor Market", Studies in Business and Economics, No. 109, (New York: National Industrial Conference Board, 1969), p. 18.

[11] Yett, "The Chronic 'shortage' of Nurses," p. 364.

[12] W. Lee Hansen, "'Shortages' and Investment in Health Manpower", in The Economics of Health and Medical Care, ed. by S. J. Axelrod (Ann Arbor: University of Michigan Press, 1964), p. 80.

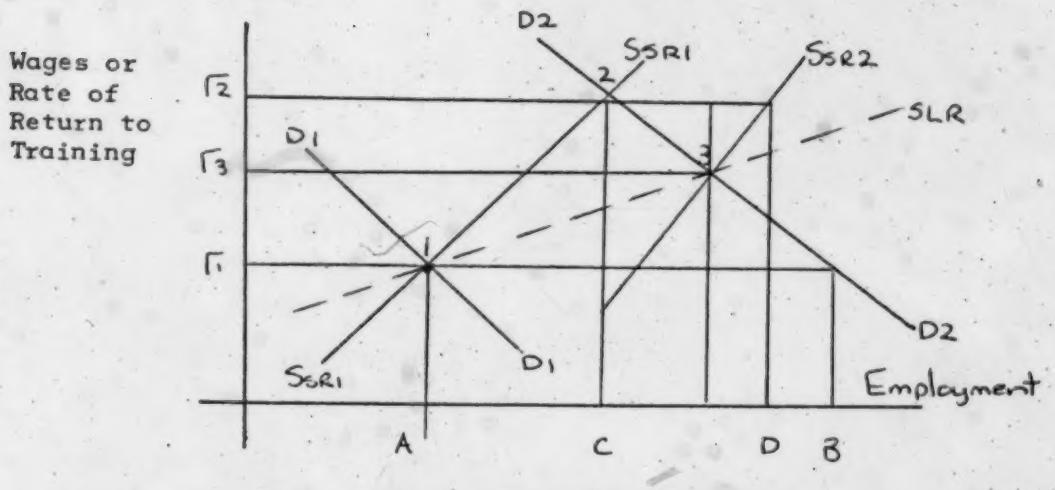

Fig. 1.2 Short- and long-run shortages

Training for a higher degree takes an observable time period. During this period an application of the Blank and Stigler definition will identify two short-run equilibria: a short-run Blank and Stigler 'shortage' followed by a 'surplus'. These are shown in Figure 1.2 as follows.

I From equilibrium at 1 demand shifts to D2 and a short-run shortage AB is reported. Equilibrium is at 2 in the short-run.

II Output from training institutions reaches the market shifting supply to SSR2. Equilibrium is at 3 in the long-run. A short-run surplus CD is reported.

III AB appears as a shortage in the long run, looking back from 3 to 1.

Hansen[13] suggested that the analysis be conducted using internal rates of return to graduate education instead of wages. The internal rate of return to graduate education is that discount rate which equates the present value of the increase in future income due to graduate education to the present value of the foregone income, training and other costs of graduate education. The

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[13] Ibid. p. 80.

student is presumed to have a criterion rate of return by which to decide about proceeding with study.

Hansen's introduction of rates-of-return does more than make the analysis more general. It brings into consideration a welfare criterion for 'surplus' and 'shortage'. Thus we may separate 'short-run Blank and Stigler shortages or surpluses' by the criterion of their occurrence at rates-of-return above or below some private or social criterion rate-of-return. Thus 'shortages' occurring at rates of return too low to induce 'long-run' response, and 'surpluses' occurring at rates-of-return not low enough to induce 'long-run' response would appear to have implications of under- or over-investment in training.

It has been shown that there is a bias in this approach to the measurement of shortages.[14] Lindsay has pointed out that the individual obtains his return on education in the form of increased wages. This results in the cost of leisure rising, which leads the individual to adjust his working time and his leisure time. For the individual, the income difference he obtains does not give an unbiased measure of the increase in his well-being. Furthermore, this is so whether or not the income measure is standardized at working times from before or after the receipt of education. Unambiguous measures are suggested, which require the use of working times to standardize income increases. Both these measures use conservatively biased indicators, so that it is possible that neither a surplus nor a shortage would be indicated when the market was not at equilibrium.

The fundamental weakness of all these alternatives is inherent in the mode of analysis used. Comparative statics, "meaning ... the investigation of changes in a system from one position of equilibrium to another without regard

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[14] C. M. Lindsay, "Measuring Human Capital Returns", Journal of Political Economy, LXXIX, No. 6 (1971), 1195 - 1215.

to the transitional process involved in the adjustment"[15] omits, by definition, the study of the adjustment mechanism whose behaviour would be the prime object of policy. Indeed Bowman states that "judgements concerning long-run shortage and excess and, more important, concerning policies relating to these, require examination of how the system operates" (to allocate skills, and levels and types of education).[16]

Arrow and Capron's Model

Kenneth J. Arrow and William M. Capron provide a model and definition of "dynamic shortages" which suggests "a more detailed account of the price-adjustment mechanism than the bare statement that price varies according to the inequality between supply and demand."[17] Their model is explicitly dynamic. They do not assume that all observations are equilibrium values, so that the observation of a discrepancy between demand and supply schedules at ruling prices is possible. The disequilibrium situation also makes it possible to observe a variety of prices and associated quantities exchanged of the same good at any one time.

In order to understand the Arrow-Capron model it is useful to bear in mind the pure theory of demand and supply. Thus for the individual or firm the demand (supply) function relates the quantity demanded (supplied) to the given

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[15] Paul A. Samuelson, Foundations of Economic Analysis, Harvard Studies, VLXXX, (Cambridge: Harvard University Press, 1947) p. 8.

[16] Bowman, "Educational Shortage and Excess," p. 457.

[17] Kenneth J. Arrow and William M. Capron, "Dynamic Shortages and Price Rises: The Engineer-Scientist Case," Quarterly Journal of Economics, LXXIII, No. 2, (1959) pp. 292-308. The discussion was prompted by the purported technological gap between the U.S.S.R. and U.S.A. which followed 'Sputnik'. It deals with shortage.

price by way of a complete, maximising calculation of a rational actor ceteris paribus. Market demand (supply) functions are summations at given prices of these ceteris paribus individual functions.[18]

Market equilibrium occurs where an intersection of market supply and demand functions occurs such that, at one and the same price, complete rational calculation by suppliers results in a summation which exactly equals the quantity resulting from a summation of the results of complete rational calculation by demanders. Whereas individuals are in equilibrium at any point on their individual supply and demand function, their equilibrium does not imply the equilibrium of the market. Market equilibrium requires congruence of individual decisions in sum, in the sense of market clearing at one price. The pure theory, with its ceteris paribus requirement, tells us nothing about the possibility of observing a market equilibrium because it says nothing about the occurrence of ceteris paribus conditions.

Arrow and Capron perform two tasks. They specify a plausible sequence of conceivably observable events by which a market equilibrium might be reached under ceteris paribus conditions. They then consider one of the possible variations excluded by the ceteris paribus conditions, an exogenous increase in demand, and specify conceivably observable events and observations under that particular set of circumstances. Their analysis is short run in the sense that no consideration is given to the possibility of shifts in supply functions as reactions to rising prices.

In the case of ceteris paribus market adjustment to equilibrium, Arrow and Capron "hold that the process by which an economic agent moves towards its

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[18] Yett, "The Chronic 'Shortage' of Nurses," p. 367, seems to think that these definitions are unusual, although in what sense he does not make clear.

own internal equilibrium is an integral part of the process by which the market as a whole comes into equilibrium".[19] In Figure 1-3 the supply function and the lines D1 and D2 represent market supply and market demand functions as specified in the pure theory, D2 representing the situation after a shift from D1, resulting, for instance, from an increase in government calls for tenders on research and development contracts. The market is initially in equilibrium at A, when D1 shifts to D2. Although the individual firm is unlikely to calculate its individual

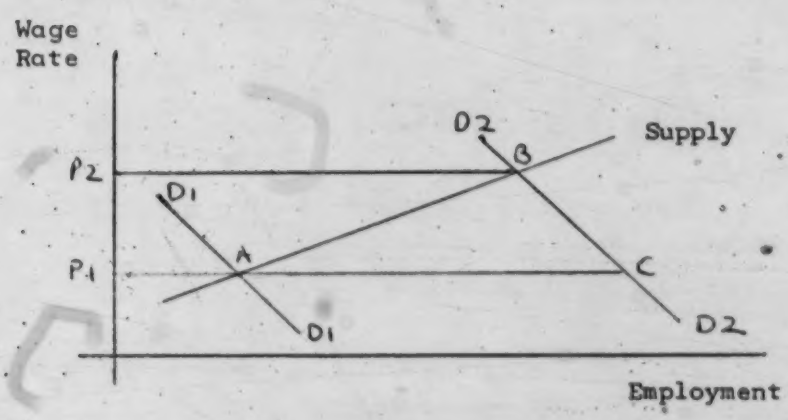

Fig. 1.3 Dynamic shortage

demand function (or even to be able to do so) it becomes immediately aware that it should hire more research personnel and attempts to do so at wage level P1. It will be unable to hire at this wage because total supply is unchanged and all firms were in equilibrium at this price; no employees are prepared to change jobs at the same wage rate. The firm therefore learns that it faces an upward sloping supply of labour curve and is forced to calculate the number of new employees it wishes to obtain, assuming as given some higher level of wages than P1. It may under-or over-estimate its requirements. Having made its new calculation

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[19] Arrow and Capron, "Dynamic Shortages and Price Rises," p. 293.

it may be able to hire all its estimated requirements and reach an equilibrium.[20]

Each firm will eventually attempt to hire at wage level P1 -- each will fail, and most will immediately complain of the 'national emergency' which such a 'shortage' implies. This 'shortage' would be AC; however, it is not likely that firms would be aware of its size. Each firm will then calculate, as best it can, the numbers it requires at higher salary levels and proceed to adjust its offers upward until the required number is obtained (or, which is the same thing, falls to zero). If firms refrain from raiding it is possible that all firms could reach internal equilibrium at different wage levels.

Market equilibrium occurs when wage levels become uniform between firms and within firms (between original and new employees). That is, firms must make the wages paid their employees uniform and adjust the rate they pay to protect themselves from losing employees to firms paying higher rates in the same industry. Arrow and Capron point out that awareness that the marginal cost of hiring is higher than the new wage paid in disequilibrium conditions will work to

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[20] Clearly there is some truth to the saying 'time is money' under these circumstances. In a market containing many firms, the first firm to raise its wage offer has a chance of filling its requirements at that wage level immediately, forcing its competitors to raise their offers to higher levels. Obviously the advantage is temporary in the sense that further adjustments will have to be made, but profits earned on output from labour hired at less than equilibrium prices are not reallocated, and further adjustments allow that firm to fire some new employees as wages rise. But note that such behaviour implies that the firm is not taking wages as given.

In this analysis it is implicitly assumed that the elasticity of substitution of research personnel with advanced training for those with less training is zero. The case of non-zero elasticity should be examined. Empirical work is needed to examine this elasticity.

slow down the rate at which salary offers rise.[21]

The lag in response of salaries to excess demand in a market is therefore very complex. The time required for the first firm to recognize that a shortage exists at current salary levels, and for it to decide on and calculate requirements at higher salaries, enters additively. That firm's action will trigger action by all other firms, if they have not already started to react, because the higher salaries will cause them to fear losing employees and also force them to calculate their requirements at higher salary levels. The network of possibilities then becomes immense and the total lag is some function of the calculation times of each firm, the learning times of each firm, and the reaction times of both firms and employees.

Arrow and Capron extend this analysis by postulating a continuous rightward shift of the demand function and a constant reaction speed, defined as the "ratio of the rate of (average) price rise to the excess of demand over supply".[22]

The result of continuing rightward shifts in demand is that shortages do not approach zero, because at every instant employers will wish to hire more employees than current average wages draw forth. This situation, the authors call a dynamic shortage whose magnitude is dependent "upon the rate of increase

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[21] Arrow and Capron, "Dynamic Shortages and Price Rises" p. 298. In a previous note it was indicated that there are short term inducements for a rapid adjustment as well. It should be pointed out that if firms have an expectation that in the long run supply will adjust so that they will be able to obtain their requirements more cheaply, then there is a further incentive to slow adjustments as much as possible by interfering with information flows and antiraiding agreements etc., and to attempt to 'speed up' the long run adjustment by such things as loud screams of 'shortage' (at current prices).

[22] "Dynamic Shortages and Price Rises," p. 299. The context implies average price. Reaction speed must bear a relation to the lag of price adjustment just discussed, but it is not clear that a constant reaction speed implies a constant lag.

in demand, the reaction speed in the market, and the elasticity of supply and demand.[23]

By putting forward a plausible adjustment mechanism whose actors can be observed, this model provides a hypothesis but leaves the empirical worker worse off. The data are no longer simplified by the useful assumption that it represents short run market equilibria. Further, not all of the individual demand functions exist during adjustment so that the size of a 'shortage' is not observable, although we have a better idea of behaviour of this unobservable through time.[24] Yett points out, that, although the model may lead one to consider vacancies as a measure, "monopsonistic and oligopsonistic employers will express the desire to hire more workers at the equilibrium wage, vacancies will be reported even though there is no 'dynamic shortage'."[25]

Yett attempts to modify the Arrow and Capron model to provide for measurement, by redefining demand "as each firm's best estimate of the labor it

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[23]Arrow and Capron, "Dynamic Shortages and Price Rises," p. 299-300, notes 7 and 8 provide the mathematical formulation and proof of these and other results for single markets. Arrow has elsewhere introduced multiple market questions in which the reactions of other markets to adjustments in the one under consideration must be considered. K. J. Arrow, "Price - Quantity Adjustments in Multiple Markets with Rising Demands," in Proceedings of the First Stanford Symposium on Mathematical Methods in the Social Sciences, ed. by K. J. Arrow, S. Karlin and P. Suppes, (Stanford, California: Stanford University Press, 1959), pp. 3-15.

[24]There has been some recent work on methods of estimation for markets in disequilibrium. Unfortunately this work requires the continuous existence of aggregate demand and supply functions in the market while Arrow and Capron argue that for identifiable periods, while the agents are making up their minds and until equilibrium is again established, demand and supply functions do not exist. See Ray C. Fair and Dwight M. Jaffee, "Methods of Estimation for Markets in Disequilibrium". Econometrica, 40 (May, 1972) 497-514, and Ray C. Fair and Harry H. Kelejian, "Methods of Estimation for Markets in Disequilibrium: A Further Study", Econometrica, 42 (Jan. 1974) 177-190. The methods of these authors may fit the Blank and Stigler model.

[25]Yett, "The Chronic 'Shortage' of Nurses," p. 379.

wants at the existing wages, (so that) ... market demand would represent the sum of their desired employment goals."[26] In Yett's model, recalculation does not occur after initial estimation, and firms react first to the demand shift and then to equalise factor prices within and between themselves. Then, he claims, "a 'dynamic shortage' can be measured at any time by the reported job vacancies."[27] He is apparently considering the absence of monopsonistic or oligopsonistic elements in these markets.

The Arrow-Capron model is certainly economic, can be shown to be symmetric in the sense that 'dynamic surpluses' can meaningfully be defined, but precise measurement does not seem possible, and the interpretation to be placed on existing price-quantity data is not clear.[28] If a 'dynamic shortage' could be detected with certainty, then policy making would be simplified because the model identifies the pertinent agents.

The most important deficiency of the Arrow-Capron model is its dependence on the stupidity of its agents. As noted previously, it is in the interests of firms to use their knowledge that the quantity supplied of labour increases with increases in salaries to make gains in disequilibrium situations. No firm would act as if salaries were given when it became apparent that the labour market was out of equilibrium.

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[26] Ibid, p. 368. Yett mistakenly claims his redefinition to be "more consistent with traditional economic theory" and compounds the error by stating that "such an 'effective' demand curve would be to the left of the Arrow-Capron curve." This has the absurd connotation that the best estimate will always be an underestimate.

[27] Ibid., p. 369.

[28] The Arrow-Capron model has been applied in a surplus context by M. Blaug, R. Layard, and M. Woodhall, The Causes of Graduate Unemployment in India (London: Allen Lane the Penguin Press, 1969). They use an alternative definition of reaction speed.

Modification of the Arrow-Capron framework has been suggested by Lester Bumas. When Hansen published an extension and an application of his reformulation in 1967,[29] he was promptly attacked by Lester Bumas.[30] Bumas argues that shortages should be defined quantitatively as the "... amount by which demand exceeds supply at prevailing salary levels."[31] Shortages can have two effects. Their price effect is to raise relative salaries and rates of return. However, argues Bumas, this effect has not been well supported by empirical evidence on the relationship between industry wage rates and relative changes in employment. Shortages also bring about a substitution effect in which under-employment is reduced. This effect is quite slow according to Bumas. In addition, Bumas argues that the supply of labour is responsive to vacancies and may respond to vacancies before price effects occur. In that case " ... the responsiveness of supply to job vacancies (i.e., the 'shortage') quenches the very force which should ultimately cause salary increases."[32] He suggests that the structure of salaries will have a tendency to remain stable over time and presents some data in support of his hypothesis. In addition, Bumas compares the behaviour of the ratio of engineering job vacancies to non-agricultural job vacancies with Hansen's analysis of engineering shortages. He notes that the two sets of data differ in their estimates of the timing of the start and peak of recent shortages.

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[29] W. Lee Hansen "Economics of Scientific and Engineering Manpower", Journal of Human Resources II,2 (Spring 1967), 191-215.

[30] Lester O. Bumas, "The Economics of Engineering and Scientific Manpower: A Comment", Journal of Human Resources III, 2 (Spring 1968), 246-252.

[31] Ibid., p. 247.

[32] Ibid., p. 248.

If employers expect a supply response to vacancies and a future decline in salaries demanded, then, depending upon their planning horizon and the time required for the expected supply response, employers will avoid offering relative salary increases in times of shortage if salaries are rigid downwards.

Bumas's critique of Hansen suggests a modification of the Arrow-Capron framework to include not only exogenously shifting demand, but shifts in supply related to the size and duration of observed shortages. This suggestion leads to a breakdown of the model because it makes the supply of labour dependent upon the relative position of the demand for labour function. Here again rational agents would be led to take their anticipations of the behaviour of others into account. The supply of labour would not be well defined away from equilibrium. This problem might be resolved by incorporating expectations into the model of the supply of labour, and basing expectations on pre-determined data rather than current events.

Finally, recall that both major models assume that agents take the behaviour of others and of wages to be outside their realm of influence. This appears to be a fundamental weakness in a situation in which bargaining has a tendency to be institutionalized. Bargaining can have no valid use in a situation in which each party considers that his eventual welfare cannot be affected by the behaviour of others. If this assumption is not valid then the models can be useful only at equilibria but cannot predict where these equilibria will arise. The simplest way of convincing oneself of this is to refer back to the theory of exchange and ask which of a range of allocations within the set of allocations which improve the welfare of each agent, will be chosen when the price ratio is <u>not</u> given externally. The standard answer is that that will depend upon the bargaining strengths of the protagonists. In short a game theoretic formulation, if it were simple enough, would improve our understanding of adjustment in this

market. The models discussed in this thesis do not account for this point. It constitutes their fundamental weakness.

Other Models of Shortage

Other models of shortage, which have been proposed, rest upon specification of the manpower requirements of particular national goals and the comparison of these numbers with estimates of the available manpower. Such models are not included in this study because they presuppose the capacity to specify exact national goals, and the exact manpower required to meet those goals. They also imply that manpower may be obtained in the precise quantities required. Whatever one's view about the existence of such capacities, these presuppositions do not allow the study of behaviour in these markets. In short these models assume that the problem to which this study is addressed has in fact been solved.[33]

A further general point regarding the analysis of 'shortages' and 'surpluses' has not been given adequate attention. It should be noted that the elasticity of substitution of trained for untrained, or of trained in one way with trained in another way, is an important measure of the way relative shortages or surpluses would adjust themselves. In this connection, Mary Jean Bowman has commented that " ... we often fail to see that shortage in one thing normally implies excess in another and vice versa."[34] This suggests that fruitful analysis cannot be performed in ignorance of the particular demand functions involved.

Probably because the problem of surpluses of highly educated labour has

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[33]See Hugh Folk, The Shortage of Scientists and Engineers, Studies in the Social Implications of Science and Technology (Lexington, Mass.: D. C. Heath and Company, 1970) Ch. 1 for discussion of such models.

[34]"Educational Shortage and Excess," p. 448.

not been prominent until quite recently, much of the literature reviewed has concerned itself with shortages.[35] Under shortages, little resistance is likely should an employer offer higher salaries. Under surpluses, however, a very different circumstance presents itself. The possibility of lowering salaries in current money values without employee resistance is remote. In the academic market for example, individuals are hired at more junior ranks or at less prestigious institutions than was previously customary.[36] The analysis of surpluses should take into account this possible asymmetry in salary behaviour.

Related to the possibilities of substitution and of downward rigidities in money salaries is the phenomenon of unemployment. Obviously its extent depends upon these and other factors, but the existence of unemployment in one market will have effects upon behaviour in other markets. The nature and timing of these reactions clearly will affect the observed size and duration of shortages or surpluses.

It has been pointed out that a combination of the possibility of substitution and the downward rigidity of wages in the traditionally highly educated occupations may lead to unemployment being pushed from high education occupations to low education occupations.[37] This arises because highly educated individuals may choose to enter the lower education occupations rather than remain unemployed. The divergence of unemployment rates may become so great that private decisions will rationally favour higher education because of the stucture of unemployment, even when there are no openings at all in those occupations

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[35]One exception is Marc Blaug, P. R. G. Layard, and Maureen Woodhall, The Causes of Graduate Unemployment in India.

[36]See for instance John R. Niland, "Allocation of Ph.D. Manpower in the Academic Labor Market," Industrial Relations II, No. 2 (May 1972): 141-56.

[37]See Blaug, Layard and Woodhall, The Causes of Graduate Unemployment in India, Ch. 1.

requiring higher education. Under circumstances in which job changing is difficult it may also be rational for graduates to spend long periods waiting for a job. In fact, the private rate of return to higher education may rise as the unemployment rate among the less well educated rises, lowering the foregone income incurred during higher education. This may hold even if the wage rates in both occupations are exactly the same. The importance of such trickle down phenomena may be reduced if employers are unwilling to hire those more highly trained than required, fearing that the individual will move to a better offer as soon as it arises, or that he will reduce the productivity of his workmates.

Any discussion involving private calculations of rates of return must assume that students are aware of labour market conditions while making their decisions. Study in the United States has confirmed this, while Canadian studies are less encouraging.[38]

All of these aspects of the labour market may influence its behaviour and deserve consideration in a model. The equilibrium shortages reported by imperfectly competitive employers may well affect the expectations of potential employees, as do forecasts of surplus or shortage made by planners. The market interdependencies reflected in the highly educated seeking to substitute for the less highly educated, perhaps supported by rigidities in wages against downward changes, will affect the allocation of labour.

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[38] See Richard B. Freeman, The Market for College Trained Manpower: A Study in the Economics of Career Choice, (Cambridge, Mass.: Harvard University Press, 1971) and David A. Dodge and Neil M. Swan, "Factors Influencing Career Choice of Students: An Empirical Examination of Some Aspects of the Neo-classical Theory of Choice in Labour Markets," Discussion Paper No. 48, Institute for Economic Research, Queen's University, May 1971.

Some Discussions of Recent Events

The emergence of surplus in the labour market for higher degree holders in the late 1960's and early 1970's has prompted some discussion. Papers by R. B. Freeman and by Stephen P. Dresch are discussed here.

Dresch concentrates on undergraduate education and considers graduate education only in passing.[39] He argues that enrolment in universities and the consequent supply of educated manpower is a function of demographic trends and of the relative salaries received by the educated. The demand for educated manpower is related to the rate of technological change and the stock of educated persons available in the labour force.

This model is applied to explain the 1960's boom and the 1970's bust in higher education. He explains the 1960's boom as a reaction to the 1950's, when the limits to technological advance imposed by depression and war were removed but the age group whose education needed improving contracted. The resulting increasing rate of college attendance was carried over onto a growing age group in the 1960's giving rise to very rapid increases in undergraduate and graduate enrolment. The future predicted by this simulation is of steady and then declining university enrolments until ... "the entire net addition to the capacity of the higher-education system over the decade roughly 1967-1977 ... will be redundant by the year 2000."[40]

In calibrating his model Dresch finds a high elasticity of substitution of

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[39] Stephen P. Dresch, "Demography, Technology and Higher Education: Toward a Formal Model of Educational Adaptation," Journal of Political Economy, Vol. 83, No. 3, 1975 pp. 535-569. In view of the discussions of Chapter 3 below it is interesting to note that Dresch attributes the dramatic increase in the share of research activity obtained by universities in the 1960's at least partly to the record rate of growth of graduate education.

[40] Ibid., p. 563.

educated for uneducated labour.[41] This supports a similar conjecture made independently in this thesis with regard to graduate students and teaching staff in universities (see Chapter 3).

Dresch's model of educational adaptation is essentially an equilibrium model. It emphasizes the role of technology in influencing the labour market and relative wages. Relative wages affect the enrolment choice of the appropriate age group. Graduate students and doctoral output are not discussed but the technology within which they are used will clearly have similar effects on enrolment choices. It will be argued that in this case there is also a direct effect on graduate student enrolment because graduate students are involved directly in providing education as well as looking forward to employment after graduation.

Freeman[42] evolves a dynamic model of the market for physicists in the United States, based on a cobweb framework which incorporates the lag between enrolment and graduation. He shows that graduate enrolment in physics is sensitive to salaries but with rather short lags compared with the training period. He does not estimate the effect of stipends or the relationship between stipends and salaries. Salaries of physicists have been responsive to demand influences in the past but can be expected to come under the influence of supply in future. He expects that salary adjustments will reduce enrolments and raise employment opportunities thus buffering the market from a decline in the demand for doctorates.

The university is a passive agent in the analyses of Freeman and Dresch.

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[41] Ibid., p. 551. He also refers to other studies confirming this conclusion at footnote 6, p. 548.

[42] R. B. Freeman, "Supply and Salary Adjustments to the Changing Science Manpower Market: Physics, 1948-1973", American Economic Review, Vol. 65, No. 1, (March 1975) pp. 27-39.

It simply educates the students which come to it and has no behaviour of its own which might affect the long term forecasts they make. This is remarkable when one considers that the university does have an intimate interest in both the demand and supply sides of the doctoral labour market.

Both analyses assume instantaneous equilibrium. Dresch introduces dynamics by demographic and technological change while Freeman uses a lag in production to get the dynamism of the cobweb cycle. In Freeman's case it is necessary to assume that the agents involved never learn to adapt their behaviour in their own interests - a comment which applies to all cobweb systems.

Neither model accepts the proposition of instantaneous disequilibrium. Indeed the word 'surplus' is conspicuously absent from their discussions. In this thesis it is hoped to suggest a model of instantaneous disequilibrium in which the behaviour of universities and other market participants enters in a more central way. A theory of the market for automobiles which ignores the behaviour of automobile firms would be considered deficient. Surely then theories of the market for doctorates which ignore universities are deficient.

In Canada Zsigmond has recently set out the demographic problem facing universities.[43] He points out that even with constant participation rates university enrolment will begin to fall in Canada in the early 1980's and will return to approximately 1980 levels by the turn of the century. In short, present university capacity should be adequate almost until the end of the century. He points out that students may not maintain their participation rates and that expenditures on education in real terms will not fall but he never makes explicit the likely behaviour of universities over this period.

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[43] Zoltan Zsigmond, "Impact of Projected Population Trends on Post-Secondary Education 1961-2001", a paper presented to the Statistical Science Association of Canada, Edmonton, Alberta, 30 May 1975. Mimeo. 38 p.

Disequilibrium Theory

It has been suggested that a disequilibrium analysis of the market for higher degree holders would be attempted. Hal Varian[44] has published a theory of persistent disequilibrium in which prices adjust only to effective excess demand, the remainder of excess demands being removed by quantity adjustments such as unemployment. The reader will recall that a similar conception was suggested by Bumas and is discussed above.

When an excess demand function takes into account quantity signals Varian calls them effective excess demand functions. The effective supply of new doctorates will be less than the total supply by the number of new doctorates who withdraw from the market rather than face unemployment. Effective supply is determined after assessing the quantity limitations in the market. The supply of graduate students to universities is subject to quantity signals (like grade point average requirements, dropout rates and doctoral unemployment) as well as price signals (like graduate stipends and doctoral salaries).

Prices are normally assumed to rise when excess demand rises and to fall when excess demand falls. If excess demand is measured after quantity signals have been taken into account then price adjustment can come to equilibrium without total excess demand being satisfied. Depending upon the behaviour of the quantity signals and the consequent quantity adjustment, disequilibrium can persist or not. If for instance quantity signals are also a function of excess demand then there might be a variety of possible scenarios resulting in equilibrium being restored. For example a surplus of graduate students caused by inflexible stipends might be adjusted by the quantity signal of high grade point average requirements. Some potential graduate students would be discouraged by their inadequate grade

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[44] Hal R. Varian, 'On Persistent Disequilibrium', Journal of Economic Theory, Vol. 10, No. 2 (April 1975) pp. 218-228.

point averages, by their fear of failure, or by having to finance the whole of their expenditures from their own sources.

Some further discussion of price adjustment is given in Chapter 4.

There is a large literature on information search in labour markets stemming from the seminal work of Stigler.[45] This literature is capable of providing explanations of unemployment[46] and could form the basis of a study of the market for higher degree holders. In the case of this thesis an information search approach is not used and the literature is therefore not reviewed.

Conclusions

The available literature on shortages does not give a completely general explanation of these phenomena. This is provided by Varian and an example has been suggested by Bumas. The discussion of recent events in the market for higher degree holders tends to ignore the effects of university behaviour in favour of the larger scale effects of demography. A model which combines analyses of the behaviour of students and the labour market with the behaviour of universities has not been developed. Apart from Arrow and Capron no other commentators in this field have attempted to devise a behavioural specification for adjustment toward equilibrium.

The next Chapter attempts to document surplus and shortage in the market for higher degree holders by applying the Blank and Stigler test to available data and by reviewing Canadian university history.

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[45] G. J. Stigler, "Information in the Labour Market", Journal of Political Economy, Supplement (October 1962, No. 5, Part 2) pp. 94-105.

[46] Edmund S. Phelps et al, Microeconomic Foundations of Employment and Inflation Theory, (New York: W. W. Norton & Company Inc., 1970).

CHAPTER 2

SURPLUS IN THE MARKET FOR HIGHER DEGREE HOLDERS IN CANADA

This chapter examines the historical record in Canada for evidence of shortage or surplus of higher degree holders. The available evidence suggests that since the turn of the century there have been regular reports of surplus in the Canadian market for higher degree holders. The booms in university attendance by undergraduates and the consequent sudden increase in demand for university teachers which have emerged twice since the Second World War were the sources of the shortages of higher degree holders at that time. Their effect seems to have been to shift annual doctoral graduations upwards relative to the size of university staffs in Canada with the result that a return to more normal conditions may result in more serious long term surplus. In recent years doctorate holders have found themselves unemployed despite the predictions of market analysts. The test for a surplus, devised by Blank and Stigler and discussed in the previous chapter, is applied to recent data.

This test suggests that a relative surplus of higher degree holders had emerged in Canada by 1971. The starting salary data suggest that for Doctorates the post war shortages ended in 1963 or 1964 but that surplus began to emerge after 1967 and 1968.

Secular Over-Production?

This section investigates the proposition that Canadian universities have had a tendency to produce more graduate degree holders than the local market could absorb since at least the 1920's. The proposition of secular over-production suggests that in the absence of external changes Canada will graduate more higher degree holders than the market can absorb into employment which exploits their education.

Some of the evidence for a thesis of secular over-production of higher degree holders in Canada is reviewed. This evidence is suggestive but not conclusive. It suggests that the surplus problem is not of recent origin and that its past manifestations have been resolved by shifts in demand rather than by adjustment of production. Current surpluses are occurring at levels of doctoral output which now exceed the normal replacement requirements for university staffs.

Published Reports from University Administrators

There is no lack of instances of apparent surplus among holders of higher degrees in Canada. Anecdotes and public complaints of overproduction were occurring in the 1920's, 1930's, 1950's and again at present. The shortages due to the unusual demand conditions in the 1960's and during and immediately after the Second World War, all have clear concurrent explanations. Certainly the history of higher education is consistent with the hypothesis that Canada's higher education system, and in particular her graduate education system, tends in the long run to produce more graduates than can be absorbed without change in occupational patterns. On the other hand, the evidence provided by these reports is hardly enough to reject alternative hypotheses.

A useful starting point for an examination of the historical development of this pattern is the formation of the National Research Council in 1917. It immediately embarked on a program of scholarships to students willing to study in Canadian graduate schools. Seven scholarships in the first year taxed the capacities of Canadian graduate schools.[1] By the mid 1920's some concern about the emigration of post-graduate degree holders was being expressed in Canadian

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[1]See F. T. Rosser, "National Research Council of Canada Scholarships for Graduate Students" in Proceedings, NCCUC, Thirty Fifth Meeting, 1959, pp. 31-38.

newspapers, prompting the National Research Council to undertake to find Canadian employers for holders of N.R.C. scholarships.[2] At the same time it was claimed, that Canadian universities were having difficulty retaining teaching staff in the face of demand from industry and government. The reconciliation of these apparently conflicting events is a matter for speculation. Canadian graduate students may have been poorly informed about Canadian opportunities; Canadian universities may have been offering low salaries relative to government and industry; industry and government may have preferred to hire more experienced employees, or Canadian graduates may have received such poor training in Canada that Canadian universities would not hire them.

In 1934 Ph.D.'s along with much other labor in Canada, faced difficulties obtaining their customary forms of employment. The following reply to the suggestion of over-production was made then:

> Those..who (appreciate) what scientific research can contribute ... know that there is no <u>real</u> over-production of men with the necessary training and capacity for research ... (T)he <u>apparent</u> over-production of graduates is just cause for taking stock...[3]

Following the second World War rapid increases in enrolment, first due to returning veterans, then to increasing demands for undergraduate education by the young and finally due to a temporary increase in the younger age groups,

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[2] See the comments of Henry Marshall Tory in the Tenth (1925) and in Appendix E of the <u>Proceedings of the Eleventh National Conference of Canadian Universities</u> held in London, Ontario in 1927. There have been comments elsewhere that migration is an important adjustment mechanism in keeping Canadian per capita gross national product at or above 70 per cent of the United States' figure. See Gilles Paquet, "Some Views on the Pattern of Canadian Economic Development", in <u>Growth and the Canadian Economy</u>, ed. T. N. Brewis (Toronto: McClelland and Stewart Ltd., 1968) pp. 34-64.

[3] <u>Proceedings Sixteenth Meeting, NCCU 1934</u> Appendix B, R. Newton "Graduate Instruction in Agriculture", Emphasis in original. Newton notes Ph.D.'s applying for positions as laboratory assistants to care for a colony of experimental animals. G. S. Brett, "Graduate Study in Canada - The Arts and Sciences" Appendix A, pp. 29-33 suggests a tendency to overproduce higher degree holders.

resulted in universities encountering staffing difficulties.

But in 1958 at the National Conference of Canadian Universities speakers were pointing out that they were not then having much difficulty getting staff, although the majority of new staff were coming from abroad.[4] Those difficulties which were being encountered were concentrated in the sciences, while unsolicited applications were concentrated in the humanities and social sciences.[5]

Unemployment Statistics

The use of unemployment statistics as evidence for a thesis of secular over-production of post-graduate degrees, has been discussed by Niland in the following terms:

> High level manpower tends to be mobile and thus has the ability, mainly by working in lesser capacities, to disguise or at least delay detection of a loosening market .[6]

In spite of this, the data collected in Canada suggest that unemployment rates in Canada among recent Ph.D. graduates have risen recently, from virtually nil to 2 per cent in 1969-70, 6 percent in 1970-71, and 5 percent in 1971-72.[7] The surplus of Ph.D.'s in Canada in these years had reached such levels that they were no longer able to avoid unemployment.

For some reason higher degree holders have not avoided unemployment by downward mobility into jobs for which they are over-qualified.

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[4]See N. A. M. MacKenzie, "Staffing Canadian Universities I" in Proceedings of the Thirty Fourth Meeting: NCCU, 1958, p. 53. President MacKenzie was referring to the experience of the University of British Columbia.

[5]Colin B. Mackay "Staffing Canadian Universities II" in Proceedings 34th Meeting: MCCU, 1958, p. 58. At his university, twenty of 25 unsolicited applicants were in the humanities and social sciences. The disciplines of the 5 are not given.

[6]John R. Niland, "Allocation of Ph.D. Manpower in the Academic Labor Market," Industrial Relations 2(May 1972): 141.

[7]See Appendix A on Data for sources and further discussion.

When the demand for higher degree holders slackens, assuming no upward shifts in demand in other sectors, either doctoral graduations or migration rates will have to adjust in order to avoid a continuing local surplus of higher degree holders. Since 1948, shifts in demand seem to have been more important than reductions in doctoral graduations in halting over-supplies and preventing further under-employment of higher degree holders.

Production in Relation to Age Group and University Staff Replacement

Doctoral output in Canada shows little sign of slowing as a result of demographic limitations It has risen, as a proportion of the age group 25 to 29 years of age, in all decades since 1920, except for the 1930's.[8] Doctoral output per annum has also grown as a proportion of reported teaching staff in Canadian universities. Annual doctoral graduations have recently been exceeding 5 percent of teaching staff in Canada.[9] University replacement rates for teaching staff range from 1.5 to 2.0 percent of staff per annum and are not expected to rise.[10] Any current surplus is occurring therefore at higher rates of production relative to university staff replacement requirements than previously.[11]

Application of the Blank and Stigler Model

The Blank and Stigler model, which was discussed in the previous chapter, gives a simple test for the existence of surplus or shortage. In this section this test

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[8] See Appendix A. Table A-9. The omission of foreign students from Canadian population figures biases these proportions upwards tempering any conclusion to be drawn from them.

[9] See Max von Zur Muehlen "The Ph.D. Dilemma in Canada: A Case Study" in Canadian Higher Education in the Seventies, Sylvia Ostry, editor, sponsored by the Economic Council of Canada (Ottawa: Information Canada, 1972) 77-131.

[10] Ibid.

[11] This conclusion is unaffected by the adjustment of teaching staff data for changes in definition.

is applied in order to support the contention that surplus does exist in this market.

Tables 2.1 and 2.2 present data on the salaries of graduate degree holders and of junior academics in Canada relative to wages in manufacturing in Canada. These data enable the Blank and Stigler model to be applied to the Canadian case. In cases in which the ratios are rising the model suggests that a shortage of higher degree holders exists in the short-run relative to manufacturing labour. A relative surplus of higher degree holders is suggested when these ratios fall over time.

The drawbacks of this test are quite severe and bear repeating. It is necessary to assume that the change in relative salaries reflects an actual difference between quantity demanded and quantity supplied which occurred some time earlier. This lag has been assumed to be zero for purposes of discussion but Bumas has raised considerable doubt regarding this timing.[12] In order to use these data to show the existence of shortage or surplus it is necessary to assume that relative wage increases (decreases) are necessary for excess demand to be positive (negative). The adjustment mechanism might not be this well behaved although it is common to assume it so. In addition it might be that manufacturing labour is in surplus, not that higher degree holders are in shortage. Furthermore there could be quality changes in either or both of manufacturing labour or higher degree holders and these will change relative wages without implying excess demand (positive or negative).[13] In addition there may be restrictions on entry to some of these professions such as university teaching or engineering which do not apply to others and which also do not apply to

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[12] Bumas, "The Economics of Engineering and Scientific Manpower: A Comment," Journal of Human Resources 3 (Spring 1968): 246-252.

[13] See W. Lee Hansen, "The 'Shortage' of Engineers", Review of Economics and Statistics, Vol. 43, No. 3 (Aug. 1961) p. 253.

manufacturing labour.[14] The base period is always arbitrary., as Bowman also points out, but steady relative salaries do require a considerable amount of coincidence of events if they are not to represent some kind of equilibrium.

Average weekly wages in manufacturing were chosen for use in this test rather than average weekly earnings because they include only hourly paid labour, not professional income and because starting salaries and university salaries also exclude other income. Average Weekly Wages in Manufacturing is published in Statistics Canada, Prices and Price Indexes Cat. No. 62-002 Monthly and both earnings and wages are published in Statistics Canada, Employment Earnings and Hours, Cat. No. 72-002 Monthly. The two series are compared below:

Year	Weekly Wages in Manufacturing (Current Dollars)	Weekly Earnings in Manufacturing (Current Dollars)
1961	74.45	81.55
2	76.75	84.00
3	79.51	86.90
4	82.96	90.42
5	86.94	94.78
6	91.65	100.16
7	96.84	106.54
8	104.00	114.44
9	111.72	122.97
1970	119.69	132.75
1	130.16	143.99
2	141.47	156.10
3	152.80	167.48
1973/1961	2.05	2.05

Both series increased by similar proportions over the period under consideration.

Average weekly wages are calculated for hourly rated wage-earners only. This statistic is no longer tabulated as part of the monthly survey conducted by the

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[14] Ibid. p. 253, N.10. and Bowman, "Educational Shortage and Excess", op.cit. p. 453.

Monthly Employment, Payrolls and Labour Income Section of the Labour Division of Statistics Canada. It is now calculated. Average weekly earnings includes the incomes of salaried workers in manufacturing.

From Table 2.1 on salaries at universities the following general conclusions may be drawn. A relative shortage of academic staff existed at the close of the second world war. Following 1947-48, however, this relative shortage changed to one of relative surplus until 1956-57. In the later half of this period the indications of relative surplus are not clear and the ratios fluctuate within a relatively small range. The data suggest that from 1956-57 to about 1961-62 there was a relative shortage of academic staff. Recall that universities were recruiting abroad at that time. The ratios decline following 1961-62 indicating a relative surplus, until in 1963-64 a period of shortage begins, ending in 1967-68. Relative salaries remained constant until 1970-71 suggesting equilibrium in the market. In 1971-72 relative salaries in universities fell suddenly suggesting that surplus had emerged for university teaching.

The data sources for these tables are discussed in Appendix A. A great deal more reliance may be placed on the series underlying Table 2.1 than those underlying Table 2.2. In particular, the starting salaries series have been constructed from two different sources and neither of those sources are very reliable.

Despite these drawbacks, Table 2.2 appears to support the general conclusions drawn from Table 2.1. Furthermore there are differences in the behaviour of different faculties and of different levels of degree.

For masters' degrees a relative surplus is indicated in science, business and engineering between 1960 and 1961. In engineering this condition appears to last until 1964. With the exception of engineering, masters degree starting salaries reach a high point relative to manufacturing wages in 1962. This brief

TABLE 2.1

RATIO[a] OF MEDIAN SALARIES BY RANK AT 17[b] CANADIAN UNIVERSITIES TO AVERAGE WEEKLY WAGES IN MANUFACTURING IN CURRENT DOLLARS 1945-46 TO 1971-72

Year	All Ranks	Asst't Prof.	Lect. & Inst.
1945-46	2.18	1.89	1.37
47	2.22	1.93	1.41
48	2.04	1.86	1.33
49	1.89	1.73	1.26
1949-50	1.78	1.66	1.23
51	1.84	1.67	1.25
52	1.87	1.71	1.30
53	1.74	1.58	1.19
54	1.79	1.60	1.16
55	1.82	1.62	1.27
56	n.a.	n.a.	n.a.
57	1.82	1.60	1.26
58	1.99	1.73	1.35
59	2.14	1.92	1.48
1959-60	2.19	1.95	1.53
61	2.25	1.98	1.55
62	2.23	1.99	1.56
63	2.23	1.95	1.56
64	2.20	1.94	1.55
65	2.24	1.94	1.56
66	2.27	1.98	1.58
67	2.34	2.02	1.60
68	2.40	2.09	1.63
69	2.38	2.05	1.61
1969-70	2.38	2.06	1.62
71	2.39	2.05	1.61
72	2.34	1.98	1.54

a. Since wages are for calendar years and salaries data are for academic years, wages data for the calendar year in which the academic year starts are divided into salaries data. Hence wages data for 1963 were divided into salaries data for the academic year 1963-64. Wages data may contain overtime. Annual academic salaries were divided by 52.

b. See source Table for the institutions involved.

Source: Appendix Table A-10, and Canada Statistics Canada, Prices and Price Indexes, Cat. No. 62-002 (Ottawa: Information Canada, various years). See also Employment Earnings and Hours, Cat. No. 72-002 Monthly.

TABLE 2.2

RATIO OF MEAN MONTHLY STARTING SALARIES ACTUALLY PAID BY LEVEL OF DEGREE AND FACULTY TO AVERAGE WEEKLY WAGES IN MANUFACTURING, DIVIDED BY FOUR WEEKS PER MONTH CANADA, 1960 TO 1973

Year	Arts		Science		Agriculture		Business[d]	Education		Engineering		Social Work
	M	D	M	D	M	D	M	M	D	M	D	M
1960	1.39[b]	-	1.55[b]	2.11[b]	-	-	1.48[b]	-	-	1.61[b]	-	1.33
1961[a]	-	-	1.52	1.95	-	-	1.37	-	-	1.60	2.12	-
1962[a]	1.48	-	1.54	1.99	-	-	1.47	1.79	-	1.56	2.00	1.41
1963[a]	1.45	-	1.52	2.13	-	-	1.42	-	-	1.53	2.20	-
1964[a]	1.38	-	1.51	2.18	-	-	1.30	-	-	1.52	2.15	1.30
1965	1.45	1.92	1.57	2.04	1.48[a]	1.94[a]	1.58	1.47	2.45	1.62	2.11	1.32
1966	1.53	2.00	1.59	2.05	1.54[a]	-	1.70	1.52	-	1.66	2.13	1.41
1967	1.53	2.02	1.68	2.11	1.60	2.08	1.80	1.55	2.30[a]	1.71	2.12	1.46
1968	1.59	1.94	1.67	2.09	1.61	1.97[a]	1.81	1.71	2.26[a]	1.73	2.19	1.51
1969	1.52	2.09	1.59	2.05	1.76	-	1.71	1.46	-	1.64	2.12	1.52
1970	1.52	1.92	1.53	1.97	1.50	-	1.60	1.46	2.07	1.60	2.07	1.53
1971	1.40	1.85	1.42	1.81	-	1.88	1.60	1.63	2.05	1.49	1.88	1.57
1972	1.39	1.72	1.33	1.68	-	-	1.53	1.59	2.03	1.42	1.81	1.45
1973[c]	1.25	1.64	1.22	1.41	-	-	1.41	1.47	1.80	1.22	1.58	1.44

Notes: See Appendix Table A-11. M. denotes Master's degrees, D. denotes Doctorates.

Sources: Appendix Table A-11 and Statistics Canada, Prices and Price Indexes, Cat. No. 62-002, various years. See also Employment Earnings and Hours Cat. No. 72-002 Monthly.

relative shortage is followed by a relative surplus ending in 1964. All faculties exhibit a relative shortage of masters' degrees following 1964 or 1965, but this shortage ends in a variety of years. For business, engineering and education the shortage of masters' degrees ends in 1968, and the subsequent relative surplus carries on until 1973. Education recovered in 1971 but has subsequently returned to surplus. In social work the relative shortage does not end until 1971 but the two subsequent years have shown surplus. In agriculture the relative shortage ends in 1969 but reliable data are not available after 1970. In science the relative shortage ends in 1967, earliest of all, and the ensuing surplus continues until 1973. In arts, the relative shortage disappears between 1966 and 1967 but reappears between 1967 and 1968. The subsequent relative surplus in arts is interrupted between 1969 and 1970. All faculties suffer a relative decline in starting salaries of masters' degrees between 1972 and 1973 and, for all except social work, this is a sharp decline.

Over the period 1960 to 1973 relative starting salaries of masters' degree holders in social work have risen. In business and arts the decline is moderate at 5% for business and 10% for arts. For masters' degree holders in science and engineering relative salaries have fallen considerably, by 20% in science and by 24% in engineering. Data for education and agriculture are not available for the whole period. It does appear that the practical arts have been better able to resist fluctuations in their relative salaries than have the technological fields.

For doctorates, data for the early 1960's are scarce. Doctorates in science show a relative shortage from 1961 to 1964, when masters' degrees in science tended to be in relative surplus. In engineering, doctorates show sharp fluctuations in relative salaries, declining from 1961 to 1962, more than regaining the decline between 1962 and 1963, and then declining until 1965.

During the late 1960's relative salaries of doctorates all show a decline, indicating the onset of relative surplus. The 1973 data are the lowest relative starting salaries for doctorates observed. In science this decline commences in 1964 and is interrupted between 1966 and 1967. By 1973 relative starting salaries for doctorates in science had fallen below those for masters' degrees in social work. In engineering the decline in relative starting salaries of doctorates did not get started until 1968. Between 1965 and 1968 doctorate engineers saw their relative starting salaries fluctuate. In 1968 these relative salaries almost regained their 1963 high, but they have been rapidly eroded since then. In arts, doctorates managed to avoid the onset of decline until 1968, the year in which their highest observed relative salary occurred. Since then doctoral starting salaries fell to reach their lowest observation. In agriculture and education only scattered observations are available but the general trend is confirmed.

The considerable shift against technological fields of relative salaries should dissuade students from enrolling in these fields and should encourage employment of those graduating in these fields in future. In 1973 the Canadian Association of Graduate Schools reported:

> In the pure, applied and life sciences the number of doctoral students decreased from 6188 students in 1971/72 to 5783 students in 1972/73, which is a drop of 6.5% in one year. A similar trend is noteworthy in the master's programs from 8483 students to 8257 students, representing a decline of 2.7%. ...
>
> Over the last four years the number of doctoral students in the social sciences has increased from 2852 students in 1969/70 to 4169 students in 1972/73, a percentage increase of 46%. ... Similarly at the master's level of studies, during the same period the numbers increased from 13756 to 18142, an increase of 31.8%. [15]

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[15] Canadian Association of Graduate Schools, "Statistical Report October 1973," Compiled by H. H. Jacobs, Analyses by H. H. Jacobs and R. A. Lebrun (Winnipeg: University of Manitoba, 1973) mimeo p. ii.

These observations raise more questions than they answer. As has been observed above, the relative price-change method of detecting surplus or shortage has little appeal as an explanation of events. It is encouraging to note that there have been relative price changes which roughly accord with the conventional wisdom. In addition, the evidence suggests that the case of relative surplus, in the Blank and Stigler sense, has been observed in the past.[16]

This application of the Blank and Stigler model has confirmed that a relative surplus of higher degree holders, and of university teachers, had developed in Canada by 1973. The problem of explaining this phenomenon remains. In attempting to construct an explanation, data from the late 1940's and 1950's as well as the early 1960's may be useful because similar phenomena occurred during those times.

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[16] These results should be interpreted with caution. If the elasticities of supply and demand are lower for higher degree holders than for manufacturing labour, then, although absolute wages rise by similar proportions in both markets, the proportional expansion in numbers supplied at constant wages necessary to maintain fixed wages would be smaller for higher degree holders than for manufacturing labour. One may not easily translate relative shortage or surplus into a numerical shortage or surplus at some salary or wage level. Also these data are not reliable indicators of the timing of the onset of shortages and surpluses if there are any lags in salary movements.

CHAPTER 3

TREND AND PATTERNS IN HIGHER EDUCATION IN CANADA

The previous chapter concluded that surpluses have been frequent phenomena in the market for higher degree holders in Canada. Chapter 1 suggested that a model is necessary to an understanding of surpluses. This chapter discusses the available data and draws conclusions relevant to the structure of a model.

Universities are the central institutions in the market for higher degree holders. They are important employers of higher degree holders and an important source of new higher degree holders. Undergraduate enrolment is proposed as a measure of the output of an aggregate production relationship in which graduate students and teaching staff are assumed to be substitutable inputs.

It is argued that this technology is used efficiently because universities seek to maximise their research output by converting any surpluses from production into research. A review of the trends and patterns in the available statistics about universities is undertaken using this hypothetical framework.

The second most important agent in the market for higher degree holders is the graduate student. An analysis of the net income received by graduate students is provided. It is argued that this payment may be considered as a

factor payment.

The Outputs and Inputs of Canada's Universities

Conceptual Framework

In order to study higher education in Canada some organising framework must be used. The framework selected views universities as producing their output within a given aggregate production function. Most of the subsequent discussion is devoted to the nature and quantities of inputs and output for this production function.

This organising framework depends for its viability on the existence of a single measure of university output. Universities usually use full-time equivalent undergraduate years to measure their level of activity. This measure has been adopted for the present study.

Undergraduate enrolment is actually used as a proxy variable for the level of activity of universities. For every undergraduate enrolled a university makes available a variety of resources such as lectures, libraries, tutorials, professional time, etc. Whether or not the student makes use of these resources depends very much upon the motivation of the student and does not materially affect the level of activity the university must support. Full or empty, libraries and lectures absorb almost the same volume of resources. For each full-time equivalent undergraduate student a university must provide a given quantity of educational resources. Full-time equivalent undergraduate enrolment is an effective proxy measure of the quantity of these educational resources made available in a year.

This framework makes the increment in intellectual achievement attained by a student a function of the quantity and quality of the educational resources provided by the university and of the effort provided by the student. Hence the university cannot be held totally responsible for the failures or achievements of its students - the effort of those students is not fully within the control of the university.

Graduate student enrolment years are viewed as both output and input units. The hypothesis is advanced that the marginal undergraduate enrolment years lost by devoting resources to an additional graduate student are less than the marginal gain obtained from resources freed by graduate student activities. Therefore the model treats graduate students as a 'net' input into the production of full-time undergraduate years.[1]

Other inputs include capital equipment and teaching staff. Non-academic staff are an input but no data on them has been collected.

Such a view does not ignore research, community services and the host of other activities university people like to define as their own. Those activities are treated as means of disposing of the surplus from the activity of providing educational resources (where they are separable from the provision of educational resources). In non-profit institutions the incentive role of profits is

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[1]Graduate students receive payment from universities and this may be construed as a factor payment net of costs imposed. They are used to teach and provide clerical support services and have been credited with absorbing much of the additional teaching loads imposed on the universities after World War II. On the other hand teaching staff have grown faster than undergraduate enrolment and graduate enrolment has grown faster than either since the 1920's.

transferred to perquisites such as time for research, academic freedom and monument construction.[2] There is no reason to assume from this that maximising behaviour is absent. Research is the desired form in which universities take the surplus from their responsibility to provide educational resources to undergraduates. Because they can keep this surplus they are motivated to use the technology efficiently although this will not necessarily be apparent in total resource use because some resources are used for research only.

Data

Because of limitations in the data the statistical sections of this chapter deal with full-time and part-time enrolment rather than with full-time equivalent enrolment. The annual rate of growth of full-time undergraduate enrolment in Canadian universities averaged 4.9 percent from 1919-1920 to 1972-73. From 1919-1920 to 1932-1933 the annual rate of growth was 3.1 percent and fell to 0.9 percent between 1932-33 and 1942-43. Subsequently the average annual growth has been 6.8 percent.

The post-war period can be divided into two periods. The first of these, which lasted from 1943-44 to 1951-52, is referred to as the veterans' bulge. Spurred by federal government assistance, covering fees and living allowances, veterans flooded into Canada's universities after the second world war. Enrolments

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[2] See for instance Armen Alchian, "Private Property and the Relative Cost of Tenure" in The Public Stake in Union Power, edited by Philip D. Bradley (Charlottesville: The University of Virginia Press, 1959).

of 38,376 in 1944-45 reached a peak of 79,346 three years later in 1947-48. They then declined to 59,849 by 1951-52.

The post-war enrolment boom made itself apparent when the increase in enrolment accelerated to a higher rate following 1953-54. The 1952-53 to 1953-54 increase was 1.9 percent and was followed by a 6.3 percent increase in the next year. A glance at Figure 3-1 will confirm that this new rate of increase remained quite stable until 1967-68.

For historical perspective some participation rates based on population estimates for 20 - 24 year olds and full-time undergraduate enrolments have been calculated.[3] For 1921-22, 1931-32, 1933-34, 1936-37 and 1941-42 this participation rate remained between 3.3 percent and 3.6 percent, unaffected by the depression. It rose to 15.2 percent in 1967-68 and remained steady at about that level until 1970-71.

Sheffield noted in 1955 that if veterans on allowances were excluded from full-time undergraduate enrolment then the resulting figure amounted to a rising proportion of births in Canada 18 - 21 years earlier. From a value of 3.5 percent in 1943-44 this proportion had reached 7.0 percent by 1954-55.[4]

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[3] Population in the first-half year of the academic year was used. Estimates from Dominion Bureau of Statistics. The age group was conveniently available and is not the most suited to this purpose.

[4] E. F. Sheffield, "Canadian University and College Enrolment Projected to 1965" in Proceedings of the National Conference of Canadian Universities, 1955, pp. 39-45.

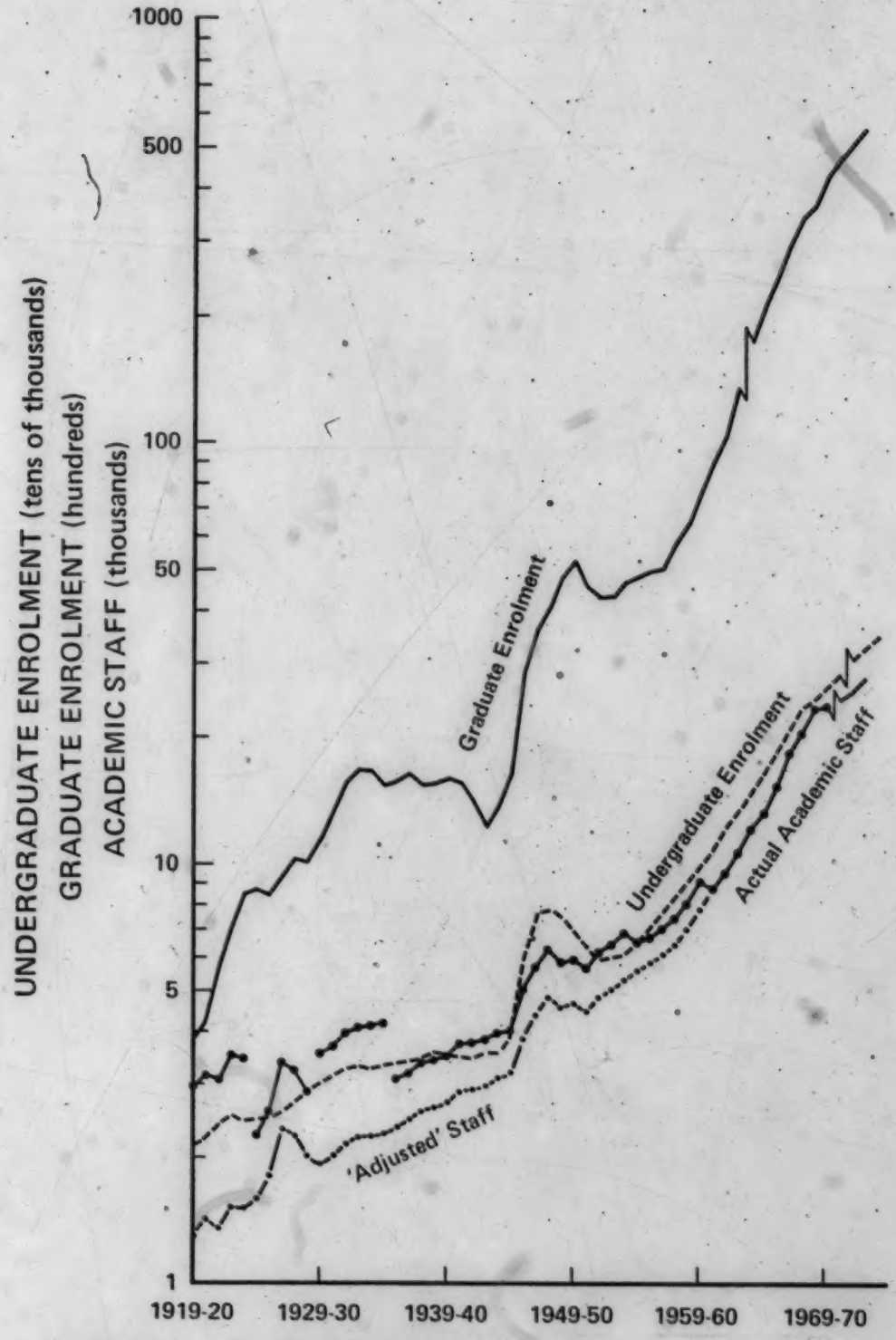

FIGURE 3-1. Graduate and Undergraduate Enrolment and Academic Staff, Canada 1919-20 to 1972-73

The early part of the post-war enrolment boom appears to have been the product of rising participation rates. In the late 1960's a bulge dating from the second world war has contributed to rising enrolments while participation rates remained steady.

To summarize, the undergraduate enrolment of Canada's universities has grown in four stages. Until 1943-44 participation rates were stable and demographic changes predominate. The veterans' return was followed by a period of rising participation rates until 1967-68 when a period of stability commenced.

An Induced Change in Factor Proportions?

Until the end of the second world war Canadian universities had not faced demands for wide participation in undergraduate education. There had been times, particularly during the depression, when they had expressed dissatisfaction with the abilities of the students enrolled. They had never been faced with undergraduate teaching responsibilities of sufficient scale to divert their members from the pursuit of scholarly work. The return of the veterans was their first experience of such a flood of students. Fears were expressed that there would be a period of ten years, including the war, of aridity in scholarship in Canada.[5]

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[5] See "Report of the Committee on Post-Graduate Studies" in the Twenty Second Meeting of the National Conference of Canadian Universities, 1946, comments of Professor Wallace.

By the time of the twenty-fourth meeting of the N.C.C.U. in 1948 an approach to this dilemma had been worked out. Graduate students and graduate education were the key to maintaining the scholarly activity of Canadian university teachers. Graduate students were "...used to relieve the instructional and clerical load of present faculty members."[6] In addition, rather than risk public disfavour by refusing to enrol the less capable students, it was suggested that universities should emphasize graduate work, the screening of enrolled undergraduates for graduate work and research, and the encouragement of the more capable students by providing special facilities for honours students.[7]

In the event, post-graduate students among the veterans absorbed a great deal of the load imposed on universities by the post-war influx of undergraduate student veterans.[8] These clerical and instructional duties appear to have been concentrated in junior undergraduate courses. The practice has continued in the post-war period.

A precedent for these practices had been noted in 1934, when it was pointed out that the majority of instructors in some first year courses at

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[6]W. Burton Hurd, "Report of the Committee on Graduate Studies" in Twenty-Fourth Meeting of the National Conference of Canadian Universities, 1948, p. 22.

[7]N. A. M. McKenzie 'Presidential Address', Ibid., p. 15.

[8]See Canada, Dominion Bureau of Statistics, The Canada Year Book, 1947 (Ottawa: King's Printer and Controller of Stationery, 1947), p. 290.

Columbia and Harvard were studying for their Ph.D.'s.[9] Such procedures may have been adopted in Canada before World War II but this was not revealed in the literature reviewed. The research assistance function of graduate students was concentrated in the sciences perhaps because the activities of the National Research Council subsidize the employment of graduate students as research assistants.[10]

University Inputs

All of the inputs universities use in providing educational resources to undergraduates have to be bought in the market in competition with other employers. Universities do not have to purchase out of their own budgets all the graduate student services which they use. Some are provided freely; some are a result of outside support and some budget sources are tied to graduate student support. The total budget measures the capacity of a university to purchase inputs. Its operating budget indicates the choice of the university in the allocation of its budget between currently used inputs, such as teaching staff, and

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[9] See Sixteenth National Conference of Canadian Universities, 1934, pp. 25-26. The effect on the quality of undergraduate instruction of introducing graduate student instructors is a matter for controversy. Those who argue that the most experienced and senior scholars ought to instruct the junior courses cannot have found much comfort in the new practice.

[10] See F. T. Rosser, "National Research Council of Canada Scholarships for Graduate Students" in 35th National Conference of Canadian Universities and Colleges, 1959, p. 31. Also A. W. Trueman, "The Canada Council Scholarship Scheme," ibid., p. 39 - 47.

investment in physical capital, as well as the restrictions imposed by the sources of funds.

The growth of operating budgets is closely bound up with the sources of operating budgets and we therefore devote attention to the sources as well as to the size of operating budgets.

Operating Revenues

University operating revenues have grown from $9 million in 1921-22 to $40 million 1950-51 and $897 million in 1968-69. In 1930-31 Canada's universities' operating revenues constituted 0.297 percent of Gross National Product at market prices. This declined to 0.225 percent by 1950-51 and then rose rapidly to reach 1.127 percent by 1967-68. Total expenditures on all education in these years were 3.8, 2.6 and 7.6 percent of GNP, respectively.[11]

University operating revenues have risen at a faster rate, since 1950, than either gross national product or total expenditures on education. At the same time government, as a source of those revenues, has increased its share relative to student fees and other sources, which themselves rose by more than ten times. Government and students together contributed 90 percent of university

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[11] Sources for these data are given in Appendix A. There are some difficulties in comparing university operating revenues over time. Up to 1953-54 coverage is not universal, including only the larger universities and many of the colleges of Canada. After that time estimates are included for non-reporting institutions. Thus the increase since the 1950's is overstated.

operating revenues in 1968-69, up from 70 percent in 1931-32.

Revenues from Governments

Governments have played a large part in the financing of universities in Canada. If university sources of income for operating expenditures are classified into government, student fees, and other sources (including endowment income) we observe quite a considerable shift over the period 1921 to 1969.[12] At the beginning of this period government supplied almost one half of universities' operating income. By the end of the 1940's this had fallen to just over 40 percent. It then rose, reaching over 70 percent by 1968-69. The rise in government contributions from 1951 to 1966-67 was propelled by federal per capita grants direct to the universities in amounts which rose from $0.50 per capita to $5.00 per capita in 1966-67. These were distributed within each province according to enrolment, so that universities in provinces with a large enrolment per capita of population received relatively small per student grants. From 1952-53 Quebec universities were forbidden, by their provincial government, to accept the grants, a restriction which was broken by one university in 1958-59 and by two in 1959-60. From 1960-61 the federal and Quebec governments reached a tax-sharing agreement by which Quebec universities thereafter received the equivalent of the federal per capita grants. From 1966-67 the federal government transferred cash and taxing powers to the

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[12] See Appendix A, Table A-17.

rest of the provinces and withdrew from per capita grants itself. The yield of tax transfers of four points on the personal income tax and one point of corporation tax is adjusted to the greater of $15 per capita of the provincial population or 50 percent of the recognized operating costs of post-secondary education. High enrolment provinces were thus better provided for than under an expansion of the previous scheme. Once the 50 percent option is used, a province cannot revert to the $15 per capita option. Since 1966-67 the federal government has also contributed to research in universities through its departments and agencies.

The growth of recognized operating costs has exceeded the growth in yield of the personal income tax since 1966-67,[13] so that these arrangements are again the subject of federal-provincial discussions.

Revenue From Fees

Student fees constituted 20 percent of university operating income in 1921 rising to 30 percent in 1943-44. Demobilized veterans who wished to extend their education had all ordinary fees paid and received a modest weekly allowance. Under this stimulus fees income rose to 40 percent by 1951-52. In 1951-52 federal per capita grants to the universities began and governments increased by 12 percent of the total their share of university operating revenues. Continuing increases in this programme and subsequent transfers of taxing powers

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[13] See John B. MacDonald et al, The Role of the Federal Government in Support of Research in Canadian Universities, Science Council of Canada, Special Study No. 7 (Ottawa: The Queen's Printer, 1969), p. 73.

to the provinces beginning in 1967-68, so raised the government contribution that students were contributing only 18 percent to current income by 1968-69.

Systematic data about levels of fees have not been collected. Fees in arts grew from between $30 and $60 to between $100 and $200 in the thirty years prior to 1939. Fees in professional faculties were somewhat higher.[14] In 1966-67 undergraduate fees in arts and science ranged from $300 to $700, with the median falling about $475. Professional faculty fees were slightly higher, fees for graduate study were often lower (Range: $200 - $675; median about $400).[15]

Revenue from Philanthropy and Estates

Other sources of university operating income have declined relative to government and fees as taxation reduced the large estates and yields on endowments failed to keep pace with enrolment growth and inflation. Miscellaneous non-endowment items make up the bulk of this source and their variation is not easily explained. In the post-war period governments have driven church philanthropy out of universities almost totally. There may have been a consequent loss of flexibility and variety in the educational resources

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[14] W. E. McNeill, "The Increasing Cost of Education" in Eighteenth National Conference of Canadian Universities, 1939, pp. 12-18.

[15] Canada, Dominion Bureau of Statistics, Tuition and Living Accommodation Costs at Canadian Degree-Granting Universities and Colleges, 1966-67, Cat. No. 81-219 (Ottawa: Queen's Printer and Controller of Stationery, 1966). Available as a special statement in 1965-66 and annually thereafter.

available to Canadian undergraduates.

Similar university revenue and expenditure data have also been analyzed by Stager. He examines these data by region and calculates price indexes and real costs for the period since 1941.[16] He also analyzes current expenditures data, which indicate the disposition of funds, and finds that the expenditure category 'research' has not expanded relative to 'instruction' since 1941.

Teaching Staff

The simplest means of evaluating the growth in operating inputs is to count teaching staff. This procedure may be misleading because the quality and hours of teaching of staff may have changed over the period and because there are other current inputs not accounted for.

Data on university teaching staff from 1919-20 to 1972-73 contain so many changes of definition that they cannot be used to estimate the growth rate of teaching staff over time.[17] This limits the discussion severely.

A glance at Figure 3.1 above indicates that, after a proportional correction for changes in definition by a constant vertical shift on the log-scale,

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[16] David A. A. Stager, "Allocation of Resources in Canadian Education" in Canadian Higher Education in the Seventies, edited by Sylvia Ostry, sponsored by the Economic Council of Canada (Ottawa: Information Canada, 1972), pp. 201-238, especially 210-219.

[17] See Appendix A, Table A-14.

teaching staff seem to have grown slightly faster than undergraduate enrolment for the period 1919-20 to 1972-73. The average staff to student ratio seems to have increased slightly. Of course any change in average teaching hours during this period would modify the implication for university input-output ratios.

Meltz has shown that since the late 1930's there has been a shift in the composition of university staff at 17 institutions in Canada.[18] Full professors declined from 37 percent of full-time teaching staff in 1937-38 to 21 percent in 1966-67. Lecturers and instructors also declined from 22 percent to 15 percent, but were temporarily 33 percent in 1946-47. Assistant professors and associate professors made up rising proportions of full-time teaching staff during this period. Most of the response of staff to the 'veterans' bulge seems to have been in lecturers and instructors.

Using the available data for 1963-64 to 1967-68, during which time neither series changes definitions, it is possible to calculate average and marginal staff to student ratios. For the first three periods the marginal staff student ratio was one or two hundredths below the average of 0.08. For the last two intervals the marginal ratio rose to at least 0.1 and the average staff student ratio rose towards 0.09.

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[18] See Noah Meltz, "Report of the Salary Committee," Canadian Association of University Teachers Bulletin, 16:1, p. 29.

Graduate Student Enrolments

An analysis of the behaviour of graduate enrolment in Canada is given in some detail in Appendix A and is not repeated here. Graduate enrolment has appeared more volatile than teaching staff or full-time undergraduate enrolment. Its largest declines have occurred from 1939-40 to 1942-43 and from 1949-50 to 1951-52.[19]

Most interesting is the fact that graduate enrolment was rising between 1919-20 and 1932-33 at a rate of 10.2 percent per year, only 1.5 percent per year less than its growth rate from 1942-43 to 1972-73. In other words there has been no sudden increase in the long-term rate of growth of graduate enrolment comparable in size to the doubling of the rate of growth of full-time undergraduate enrolment.

Full-time and part-time graduate enrolment was 1.8 percent of full-time undergraduate enrolment in 1919-20. This proportion rose to 3.5 percent by 1923-24 and remained below 4.0 percent until 1929-30. Full and part-time graduate enrolment rose to 5.2 percent of full-time undergraduate enrolment in 1933-34, apparently less influenced by the depression than full-time undergraduate enrolment. It remained a stable 4.5 percent of full-time undergraduate enrolment until 1940-41, when, at the outbreak of the world war,

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[19] Patriotism and expectations of veterans' assistance after the war, but not conscription, may be associated with the decline from 1939-40 to 1942-43. Conscription in Canada did not commence until the autumn of 1944. In the case of the Korean War, the association may be fortuitous. The decline in graduate enrolments from 1949-50 to 1951-52 coincides with the departure of second world war veterans from the universities.

it fell to 3.4 percent (1942-43) but had recovered to 4.6 percent by 1945-46. By 1949-50 full and part-time graduate enrolment had reached 7.6 percent of full-time undergraduate enrolment and remained in the range 6.8 percent to 7.9 percent until 1959-60. A change of definition involving the treatment of the licence degree occurred in 1961-62. Thereafter full and part-time graduate enrolment exceeded 10 percent of full-time undergraduate enrolment, reaching 15 percent in 1968-69.

Participation rates for graduate students for selected years were calculated by comparing total full and part-time graduate enrolment with the population aged 25 - 29 years. In 1921-22 full and part-time graduate enrolment amounted to only 0.08 percent of the population aged 25 - 29 years. By 1932-33 this figure was 0.21 percent. There followed an uneven decline to 0.13 percent in 1942-43 and a spectacular rise during the veterans' boom to 0.48 percent in 1949-50. This value fell back to 0.38 percent in 1951-52. By 1961-62 full and part-time graduate enrolment stood at 0.86 percent of the population aged 25 to 29 years. In the succeeding five years this increased rapidly to reach 2.40 percent by 1966-67 and 3.13 percent by 1970-71. The absence of periods of stable participation rates suggests that variations in the population 25 to 29 years of age have never been the outstanding causes of variations in total graduate enrolment. However, the population data exclude a large proportion of foreign students who were not landed immigrants of Canada. These participation rates are biased by this omission by an amount depending upon the variation in the citizenship of foreign students from year to year.

Total graduate enrolment grew at an average annual rate of 8.3 percent from 1919-20 to 1972-73. This was 3.4 percent per year above the rate of growth of full-time undergraduate enrolment. It exceeds the rate of growth of teaching staff by a lesser amount.

Graduate Student's Net Income

At the Sixteenth National Conference of Canadian Universities in Hamilton in 1934 Dean F. M. G. Johnson of McGill University raised a question to which he received no answer. Why, asked Dean Johnson, do graduate students need so much financial assistance relative to that received by undergraduates or medical students?

Graduate education yields a low private internal rate of return relative to undergraduate study, when assistance is omitted from the calculations.[20] To achieve a private rate of return closer to that offered by undergraduate study, graduate students would require higher levels of assistance than undergraduate students. In other words, graduate students would have to be attracted on the basis of current consumption benefits.

Graduate students do receive, on average, a considerable net income as a result of undertaking their studies. This net income reduces the foregone income cost of graduate studies. For the years 1956-57, 1961-62 and

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[20] This is apparent from lower yields of graduate study when assistance is included and the higher levels of graduate assistance. See David A. Dodge and David A A. Stager, "Economic Returns to Graduate Study in Science, Engineering, and Business," Canadian Journal of Economics V, 2 (May 1972), 182-198.

1968-69 net annual income of graduate students contingent upon their graduate enrolment was estimated at $925, $1,201 and $1,626 respectively.[21] The 1966-67 estimate of this figure would be $1,150 less $179 ($971) according to Dodge and Stager:[22] In 1972-73 the median income of graduate students in Ontario had reached $2,330.[23]

Undergraduates do not appear to receive as large stipends as graduate students while their fees tend to be larger.[24] Some clue as to the differences in levels of support can be obtained by examining data on federal and provincial student aid in Canada. Excluded from these data are aid to part-time students, teaching and research assistantships and contracts, hidden fee remissions and subsidized board. They include aid provided as loans, grants, bursaries, scholarships and allowances. Federal and provincial government aid to undergraduate students averaged $475 per full-time undergraduate student in

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[21] See Appendix B for estimation procedures and more detailed results. Note that these estimates exclude foregone income and income not contingent upon graduate study such as part-time earnings.

[22] Op. cit. Appendix obtained from authors. This suggests that their study underestimates the income of graduate students and therefore the private rate of return to graduate study. They also omit the part-time earnings foregone by students while including the part-time earnings received by students, thus biasing their results upwards.

[23] Council of Ontario Universities, "Graduate Student Incomes in Ontario 1972-73," (Toronto: Council of Ontario Universities, April 1974), Table II(e).

[24] Some evidence regarding fees is presented above under University Current Inputs.

1968-69 and $506 per full-time undergraduate student in 1969-70. The equivalent figures for graduate students were $1,198 and $1,170 per full-time graduate student, respectively. Alternatively, including full-time and part-time graduate students, this aid averaged $853 and $804 per graduate student in these years, respectively.[25]

Of the aid allocated to undergraduates 59 percent was in the form of loans rather than the non-repayable grants, allowances, scholarships and bursaries.[26] Only 10 percent of graduate student aid was in the form of loans. Since loan repayments come out of later earnings, the above figures should be recalculated to give non-repayable current income. On this basis in 1968-69 and 1969-70, full-time undergraduates received $195 and $208 respectively, while full-time graduate students received an average of $1,080 and $1,050 respectively.

More recent data for Ontario provide more detailed information on the distribution of graduate student incomes.[27] Income is defined in this source as ". . . funds paid to a student by, through, or with the consent of the university and which are associated in some way with his/her registration as a full-time graduate student. Loans are not included in the definition of

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[25] Calculated from Canada, Statistics Canada, Federal and Provincial Student Aid in Canada, 1968-69 and 1969-70, (Ottawa: Information Canada, 1972).

[26] Grants require demonstration of financial need. Bursaries are given for academic achievement and financial need. Scholarships are for superior academic standing and allowances are purely in recognition of full-time attendance.

[27] Council of Ontario Universities, "Graduate Student Incomes in Ontario, 1972-73 "

income."[28] These data reveal that 22% of graduate students had no income, 17% had from $1 to $1600, 12% had from $1601 - $2400, 18% had from $2401 - $3600, 22% had from $3601 - $4800 and 9% had more income than $4801.[29] The distribution of sources is also interesting.

Of the funds used to support graduate students at all Ontario universities in 1972-73, 33% came from university teaching funds, 23% came from federal awards, 18% came from staff research grants and the remaining 26% came from provincial fellowships (10%), awards based on need (2%), endowment funds (7%), university non-teaching service funds (4%), and other sources (5%). Teaching funds awards include marking duties and "awards which exceed direct remuneration for services rendered." Federal awards include fellowships and scholarships from the Canada Council, N. R. C., M. R. C., C. I. D. A., etc.[30] The predominance of university teaching funds lends credence to the hypothesis that graduate students are factor inputs for universities.

University Physical Capital

Not all the funds universities receive are earmarked for operations

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[28] Ibid., p. 1. This definition certainly fits the criterion used in Appendix B that income obtained as a result of studying should be included.

[29] Ibid., Table II (e).

[30] Ibid., Table IV (e) and p. 9.

or for capital investment. Therefore it would not be wise to ignore the capital account operations of universities in a discussion of their budgets. Some of the current account budget is available simply because universities decided not to purchase additional capital equipment out of revenues. The statistics identify capital account revenues by whether they were used to make capital expenditures.

Current expenditures for capital goods do not reflect resource use. Ideally the flow of capital services available to universities should be observed over time in comparison to the current services purchased through the operating budgets. This flow depends upon the stock of capital goods. For the period concerned the best estimate available for these purposes is cumulative expenditures of universities on sites, buildings and equipment. As Appendix A shows it is a poor substitute.

The cumulative cost of plant of Canadian universities doubled from 1921-22 to 1932-33, reaching $200 million in 1961 dollars in the latter year. It subsequently declined, reaching a low point of $160 million in 1961 dollars in 1947-48. Subsequently it has risen steadily, with the exception of a small decline from 1949-50 to 1950-51. In 1967-68 this measure stood at 1,370 million in 1961 dollars.[31]

The 1961 dollar value of cumulative cost of plant per full-time

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[31] See Appendix A, Table A-15. Note that this data differs from Hettich's estimates in recent years and that the more recent data does not allow for assets disposed of by universities. See Walter Hettich, Expenditures Output and Productivity in Canadian University Education, prepared for the Economic Council of Canada, Cat. No. EC 22-2/14 (Ottawa: Information Canada, 1971) p. 74-76.

undergraduate was $3800/student in 1920-21 and $6250/student in 1932-33. The decline to 1947-48 brought this crude measure of the capital-output ratio to $5150/student in 1941-42 and, under the influence of the 'veterans bulge', it fell to $2000 per full-time undergraduate student in 1947-48. By 1950-51 capital expenditures had raised the cost of plant per full-time undergraduate only to $2750/student. It subsequently rose to $4050/student and $6500/student in 1960-61 and 1968-69 respectively.

Relating Inputs to Undergraduate Enrolment

Table 3-1 summarizes the data collected on input and output rates of growth. If academic staff and graduate enrolments were to be used to explain the growth of undergraduate enrolment output, the residual would be negative.[32] This does not refute the model suggested above but it does imply that some change is unaccounted for in our discussion. Possibilities include the following: part-time undergraduate enrolments were omitted from the output measure;

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[32] This was confirmed by a multiple log linear regression of full-time undergraduate enrolment against the logarithms of capital stock (cumulative real cost of plant), teaching staff and total graduate enrolment, for the period 1920-21 to 1968-69. The simple Cobb-Douglas coefficient on the cumulative real cost of plant was negative (-0.34) and significantly different from zero, while staff and graduate enrolment took significant positive coefficients (0.35 and 0.42 respectively). Dummy variables were used to account for the effects of changes in definition in the teaching staff and other data on the statistical relationship. The trend coefficient was negative (-0.03) suggesting declining output from fixed inputs. This result suggests that experimenting with functional forms which do not predetermine the elasticity of substitution between each of the three factors might be fruitful.

variations in capacity utilization may have occurred over time. Also, if universities do not limit graduate enrolment to the levels indicated for efficient production of educational resources for undergraduates, then the data will lie inside the production frontier. If graduate enrolment grows relative to its efficient level over time the data will indicate declining productivity from fixed resource inputs as was noted in the previous footnote. Graduate studies may have become more popular with students over time. Declines in the average teaching hours of teaching staff would also explain this result.

TABLE 3-1

AVERAGE ANNUAL RATES OF GROWTH OF SELECTED DATA SERIES RELATED TO UNIVERSITIES IN CANADA

	1919-20 to 1932-33	32-33 to 43-43	42-43 to 72-73	19-20 to 72-73
Full-time undergraduate enrolment	3.1	0.9	6.8	4.9
Teaching staff (corrected)	4.2	3.2	7.6	5.4
Total graduate enrolment	10.2	- 2.1	11.7	8.3
Cumulated university capital expenditures[a] (1961 dollars)	6.1[a]	- 1.6	8.7[a]	3.9[a]
Civilian labour force[b]	2.3[b]	0.8	2.4[b]	1.8[b]

[a]Data for 1920-21 to 1968-69.

[b]Data for 1921 to 1971.

Source: See Appendix A. Estimates derived from regression of the form $\ln y = a + bt$ for the inclusive periods stated.

Where: y = series involved

t = year

b = 0.01 x average annual rate of growth

a = constant

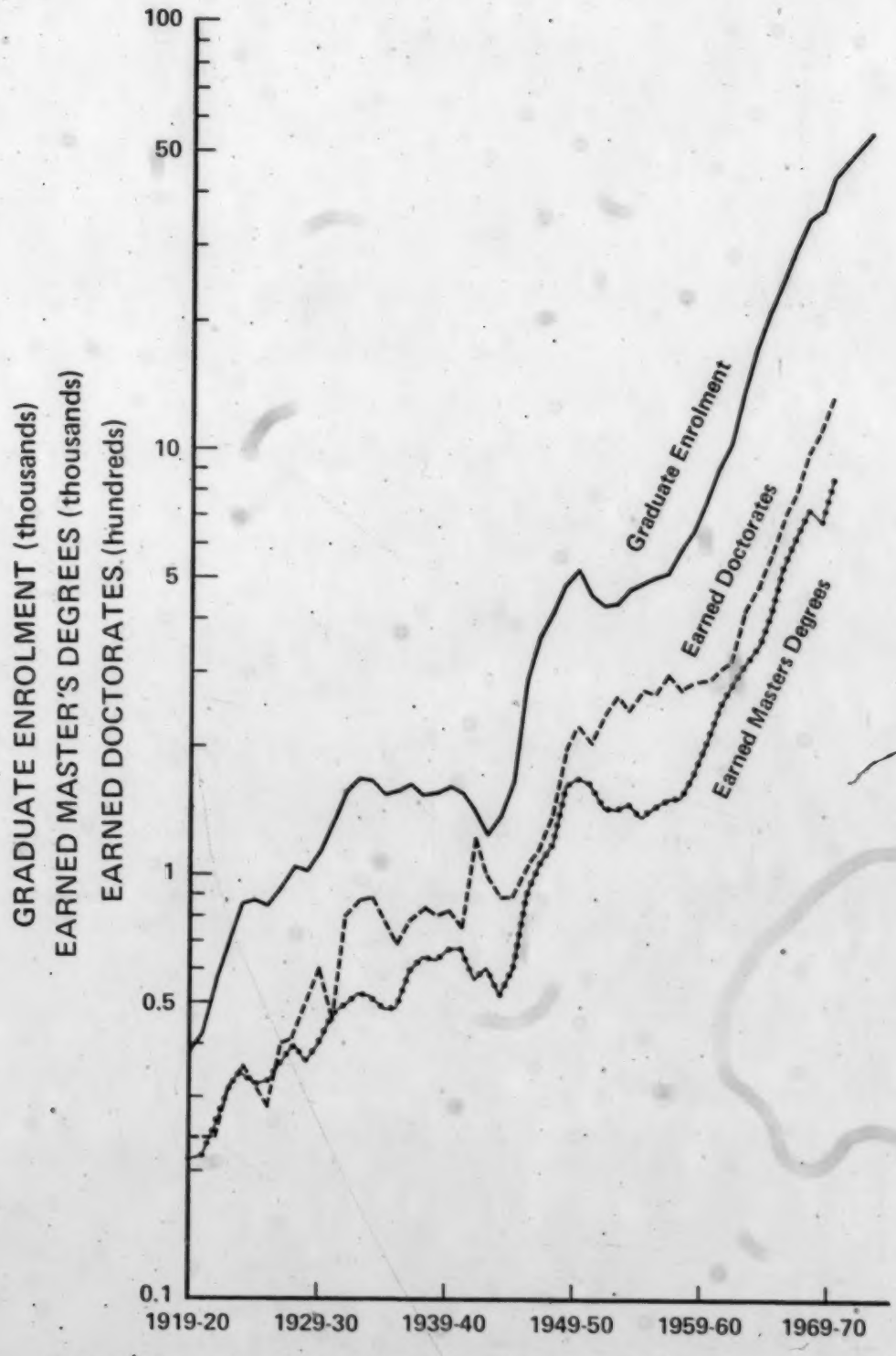

FIGURE 3-2. Earned Graduate Degrees and Graduate Enrolment, Canada 1919-20 to 1972-73

CHAPTER 4

A GENERAL MODEL OF THE MARKET FOR HIGHER DEGREE HOLDERS

This chapter presents a model of the relationship between graduate education and the labour market in which higher degree holders seek employment. This model is used to illustrate some hypotheses about the causes of surplus in the market for higher degree holders in Canada.

Motivation

The discussion of models of shortages and surpluses presented in Chapter 1 concluded that a particular case would require a careful analysis of demand and supply relations. Chapter 2 suggested that surpluses are a feature of the Canadian market for higher degree holders. Some of the components of the model were discussed previously. The relationship of the output of educational institutions to the labour market was suggested by Hansen and discussed in Chapter 1. The production function view of universities was set out in Chapter 3.

Models and Methodology

In the present study the testing of hypotheses is not the immediate objective of model building. Building a model would be justified if the model

suggested testable hypotheses. The exercise of model building makes explicit the tentative hypotheses of the investigator. If and when sufficient data become available, the model makes the testing of hypotheses more powerful and relevant to the problem under discussion.[1]

Highlights of the Model

A feature of the model is its emphasis on the behaviour of the agents involved and, in particular, on the capacity of those agents to change their behaviour under changing circumstances. The literature on the market for higher degree holders often treats behaviour as a matter of fixed proportions and only seldom discusses the changes observed in these proportions.[2] Models which contain no mechanisms for the redress of imbalance are likely to predict imbalance.

The model highlights the fact that the same agents are active in both markets and, at least for the case of universities, events in one market may very well influence behaviour in another. An example of this is the capacity universities have to substitute graduate students for staff in response to changes in the doctorate labour market and the market for graduate enrolment places.

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[1] These sentiments derive from T. C. Koopman's "Measurement Without Theory," Review of Economics and Statistics, 29 (1947), 161-172, corrected and reprinted in M. Beckmann, C. F. Christ and M. Nerlove, ed., Scientific Papers of Tjalling C. Koopman's (New York: Springer Varlag, 1970) 112-131. See also T. C. Koopman's Three Essays on the State of Economic Science (New York: McGraw-Hill, 1957), Essay II, "The Construction of Economic Knowledge," p. 142.

[2] Alan Cartter's predictions have depended upon fixed proportions. Richard B. Freeman has included behavioural change in his work.

Similarly graduate students may advance or delay graduation, within limits, in response to conditions in both markets.

Model of the Market for Higher Degree Holders

The model is first presented algebraically. Subsequently the interpretation put on each component is explained. The most direct form of the model is as a set of excess demand functions. Let:

(4.1) $$d(t) = A_d.p(t) + B_d.x(t)$$

(4.2) $$s(t) = A_s.p(t) + B_s.x(t)$$ be

corresponding sets of demand and supply relations. The associated excess demands are:

(4.3) $$y(t) = A.p(t) + B.x(t),$$

where $$y(t) = d(t) - s(t), \quad A = A_d - A_s, \quad B = B_d - B_s.$$

Equation (4.3) gives the general form of the model. Its elements are interpreted as follows:

$y(t)$ is a 2 vector, where

$y1(t)$ = excess demand at time t for graduate students in universities

$y2(t)$ = excess demand at time t for new doctorate holders, in the labour market.

$p(t)$ is a 2 vector of variables, where

$p1(t)$ = average real stipend income of graduate students net of tuition fees at time t.

$p2(t)$ = average real salary at time t of new doctorates in the labour market.

$x(t)$ is a k vector made up of the values at time t of all the other variables which affect the demand and supply relations concerned.

The matrices A_d, A_s, B_d, B_s and the resulting A, B are coefficient matrices of appropriate order. A, A_d and A_s are 2 x 2 while B, B_d, B_s are 2 x k.

The purpose of this model is to examine the actual behaviour of $p(t)$ relative to conditions under which the market might clear. Market clearing occurs when $y(t) = 0$.

Hence $0 = A\,p(t) + B\,x(t)$

It is necessary and sufficient for market clearing that

$$p(t) = -A^{-1} B.\, x(t) \tag{4.4}$$

Market clearing can be achieved for non zero $x(t)$ and $p(t)$ provided A is non-singular. This establishes the existence of an equilibrium. The structural coefficients (A) will have some influence on the time path followed by the market. The adjustment mechanism will determine whether equilibrium is achieved. Since the market regularly fails to clear, equation (4.4) does not express the actual path of $p(t)$ in the market for higher degree holders in Canada. If the market is not clearing then those responsible for setting $p(t)$ are consistently getting it wrong for some reason. Assuming good will this may be caused by ignorance of the equilibrium relationship between $p(t)$ and $x(t)$, ignorance of $x(t)$ or inability to adjust $p(t)$ quickly and correctly.

If the market is clearing in the long run then disequilibrium may be the result of lags in observation of $x(t)$ or lags in adjustment of $p(t)$. In this case

one could examine the adjustment behaviour of the market. One approach to this would be to examine how the value of p(t) actually selected from time to time differed from the value required for equilibrium.

The next section considers the basic structural relations in the model, and provides a justification for each. This serves to give the reader a feeling for the components of the model.

Subsequent discussion adds an adjustment mechanism to the model.

Outline of the Model

The components are demand and supply relations for graduate students and, demand and supply relations for new doctorates. These relations correspond to two markets; one for graduate student enrolment (supplied by students and demanded by universities) and one for new doctorates supplied by graduating students from Canadian and other universities and demanded by Canadian universities and non-academic employers.

The Supply of Graduate Students to Universities

When universities raise real annual graduate student stipends net of tuition fees, the number of graduate students seeking enrolment positions rises, other variables remaining constant. Stipends make foregone income easier to finance and reduce the immediate costs of graduate education. Consumption of graduate education and investment in graduate education are each made more

attractive.[3] Freeman shows that changes in the number of Ph.D. graduates five years later are affected by the mean dollar value of fellowships awarded per Ph.D. in the period of the enrolment decision. Changes in discounted lifetime income have a more important effect than fellowships in Freeman's results for the U.S. Because data on annual new enrollees are not available it is not possible to test whether discounted lifetime income increases its effect with time enrolled.

When universities raise the real annual salaries of new doctorates, or when other employers raise the real salaries they pay new doctorates, then the number of graduate students seeking enrolment positions rises, other variables remaining constant. The supply of students is expected to be less sensitive to the real salaries of new doctorates than it is to real net stipends.[5] Salaries of new doctorates affect only the investment motivation for graduate enrolment; the student cannot expect to receive the consumption benefit of raised salaries for some years. The effect on the investment decision is discounted to allow for the delay

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[3]For a discussion of the human capital investment model of demand for education see Theodore W. Schultz, Investment in Human Capital: The Role of Education and Research (New York: The Free Press, 1971). See also M. L. Handa and M. L. Skolnik, "Empirical Analysis of the Demand for Education in Canada," in Sylvia Ostry (Editor) Canadian Higher Education in the Seventies, Cat. No. EC22-1772 (Ottawa: Information Canada, 1972).

[4]Freeman, The Market for College-Trained Manpower, op. cit., pp. 117-123. The model proposed here owes much to Freeman's model of incomplete adjustment with the exception that more attention is paid to university behaviour in this study.

[5]The apparent conflict with Freeman's result, mentioned above, could be explained by the very high income elasticity of demand for graduate education, if the starting salaries of doctorates are correlated with per capita income. See Handa and Skolnik, "Empirical Analysis of the Demand for Education in Canada," p. 25.

before the salary can be obtained. Uncertainty about completion of studies also makes student decisions about enrolment less sensitive to future salaries. Enrolment decisions are treated as annual decisions. In this way the model incorporates an allowance for graduate students who decide to terminate their studies before completion of a degree.

The Demand for Graduate Students

Universities demand graduate students and new doctorates. To understand these demands it is necessary briefly to discuss the technology and motivation of Canadian universities.

Early in Chapter 3 the idea of universities providing 'educational resources' for undergraduates was introduced. That chapter discussed how Canadian universities have employed resources of teaching staff, graduate students and plant and equipment to provide 'educational resources' for their undergraduate students. This describes the technology of university operation but not the motivation.

A simple and reasonably comprehensive expression of the motivation of Canadian universities is that they seek to maximise their output of scholarly research subject to constraints.[6] The most important constraints are that sufficient educational resources must be provided to meet the needs of their

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[6] See Daryl E. Carlson, "The Production and Cost Behaviour of Higher Education Institutions," Ford Foundation Program in University Administration, Paper P-36 (Berkeley: University of California, 1972) and P. W. Cartwright, "The Economics of Deaning: The Care and Feeding of Homo Academicus," Western Economic Journal, Vol. 3, No. 2 (Spring 1965), pp. 152-164.

enrolment; they may not overspend their budget, and they may not enrol more graduate or undergraduate students than seek enrolment. In fact it may be argued that the last two of these have been the only effective constraints on university graduate and undergraduate enrolment in some recent years. This is suggested by financing formulae which expanded budgets with enrolment, and by the suggestion, made in Chapter 3, that graduate students add to the teaching capacity of universities even after taking their own resource use into account.

This model of university behaviour can be simply expressed as follows:

$$\text{Max } R = R(S_s - S, G_s - G, K_s - K)$$

Subject to

Adequate teaching: $t_1 U + t_2 G \leq T(S, G, K)$

Limited Budget: $b_1 + b_2 U + b_3 G \geq b_4 S + b_5 K + b_6 G + b_7$

Limited available students and staff: $G \leq G_S$, $U \leq U_D$, $S \leq S_s$, $K \leq K_s$,

$R, S, G, K, U, \geq 0.$

Where: R, S, G, K and U are, respectively, annual volumes of scholarly research completed, teaching staff, graduate students, plant and equipment and undergraduate students.

$R(S, G, K)$ is the production function for scholarly research

t_1 and t_2 are required educational resource coefficients per enrolment year

$T(S, G, K)$ is the production function for educational resources

b_1 to b_3 are revenue coefficients

b_4 to b_7 are expenditure coefficients

G_S is the number of graduate students seeking enrolment

U_D is the number of undergraduate students seeking enrolment

S_s is the available stock of academic staff

K_s is the available stock of capital equipment

The number of graduate students universities seek to enroll will decline as graduate student real net stipends rise; other things remaining unchanged. To the extent that graduate stipends are paid out of university revenues, universities will substitute staff for both teaching and research duties. This effect could be quite weak because graduate student enrolment contributes to university budgets and because not all of graduate student stipends are a charge to university budgets.

Increases in the real salaries paid to new doctorates by universities will lead to an increase in the number of graduate students which universities seek to enroll, other things remaining unchanged. Graduate students will be substituted for teaching and research staff in these circumstances.

Other variables affecting the number of graduate students which universities seek to enroll include the grade point averages of graduate students, undergraduate enrolment, and the size of the contribution of graduate student enrolment to university revenue. The effect of all these components will be positive.

If the overall grade point average of incoming students were to rise

then universities could be expected to seek to enrol more of these students. Including grade point averages in the formal model leads to considerable difficulty. It adds a quality dimension to students and makes aggregation difficult. The data are not readily collected or interpreted. Students with different grade point averages obtained in different years or at different schools may be of equivalent ability. The data are expressed differently at every school although Princeton Admissions Test data might overcome this problem. The grades accepted by universities may tend to change from time to time.

The Demand for New Doctorates

Total hiring of new doctorates will decline in response to increases in the real salaries of new doctorates, other variables remaining constant. In universities this reflects substitution of graduate students for teaching and research staff. Increases in the salaries of new doctorates are likely to lead to decreases in university hiring of new doctorates and increases in recruitment of graduate students.

Similar argument suggests that increases in the real net stipends of graduate students will lead to increases in the number of new doctorates which universities seek to hire.

Other variables which affect the numbers of new doctorate holders which universities seek to hire include undergraduate enrolment and the size of university operating budgets. Increases in revenue per graduate student, revenue per undergraduate student or in undergraduate enrolment will lead to increases in

the numbers of new doctorates which universities seek to hire.

The quantity of new doctorates demanded by the non-university sector will depend inversely on the level of real salary doctorates receive in the non-university sector.

Other factors influencing the quantity demanded include the rate of growth of real output, labour productivity and the average real salary of baccalaureate degree holders in Canada.

In equilibrium the university and non-university sectors of the labour market will offer identical salaries to equally able doctorate holders in identical jobs.[7] The demand for new doctorates is therefore treated in a single equation.

The Supply of New Doctorates

New doctorates who decide to remain in or immigrate to Canada make up the supply to the Canadian market. It is assumed that universities supply graduation perfectly elastically and that graduation decisions are based on similar calculations to those governing enrolment decisions.[8] In addition it is assumed that

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[7] Freeman relates discounted lifetime earnings to sector of employment and argues that the coefficients relate to the non-pecuniary income obtained in some sectors, e.g., teaching and research. See The Market for College-Trained Manpower, op. cit., pp. 87-90.

[8] A theory of the supply of Ph.D. graduation involving institutional prestige generated by well-placed graduates has been suggested by David W. Breneman, "An Economic Theory of Ph.D. Production: The Case at Berkeley," Ford Foundation Research Program on University Administration, Paper P-8, (Berkeley: University of California, 1970) mimeo.

at the margin the graduation of one additional doctorate in Canada reduces net immigration by not more than one. Finally, new doctoral graduates everywhere are assumed to be aware of relative salaries everywhere and to enter labour markets accordingly.

The quantity of new doctorates supplied to the Canadian labour market will increase when the salaries of new doctorates in Canada rise or when graduate student stipends rise. In the case of stipends it might be objected that a rise in stipend might lead to students delaying graduation rather than facilitating their work. This seems unlikely.[9]

Increases in salaries of new doctorates abroad, or increases in required grade point averages in Canada are expected to reduce the number of new doctorates seeking employment in Canada. Grade point average increases in this case are assumed to result in fewer Canadian students completing their studies.

The Nature of the Matrix of Price Coefficients

This section summarises the qualitative results of the previous sections. The signs of the coefficients of real net graduate student stipends, and salaries of new doctorate holders have been discussed for each of the demand and supply equations as set out in the following table.

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[9] Freeman argues, on the basis of survey and regression calculations, that stipends reduce the chronological time spent acquiring a graduate degree. This would imply more graduates per unit time. Freeman, The Market for College-Trained Manpower, op. cit., p. 109.

TABLE 4.1

SIGNS OF COEFFICIENTS OF PRICE VARIABLES IN EACH DEMAND AND SUPPLY FUNCTION IN THE MODEL

Function	Price Variable	
	Real Net Graduate Student Stipend	Real Salary of New Doctorate Holders
Demand for graduate students by universities (Supply of places)	-	+
Supply of graduate students to universities (Demand for places)	+	+
Demand for new doctorate holders	+	-
Supply of new doctorate holders	+	+

From this table it is possible to derive the signs of two of the price coefficients in the excess demand equations for graduate students and for new doctorates. If real net graduate student stipends rise then demand for graduate students falls and the supply of students to universities rises. Therefore, if real net graduate student stipends rise then excess demand for graduate students falls. If the real salary of new doctorate holders rises then the demand for new doctorate holders falls while the supply rises. Therefore, if the real salary of new doctorate

holders rises the excess demand for new doctorates falls.

The effect of increases in the real salary of new doctorate holders on excess demand for graduate students, and the effect of increases on real net graduate stipends on excess demand for new doctorates are both unclear. It is possible to state arguments for either sign for each of these parameters. For the time being it is assumed that both are negative. This assumption is discussed below.

Under this assumption the pattern of signs of coefficients in the excess demand functions, and therefore in matrix A, is as shown in the following table.

TABLE 4.2

SIGNS OF COEFFICIENTS OF PRICE VARIABLES IN THE EXCESS DEMAND FUNCTIONS

Excess Demand for	Real Net Graduate Student Stipend	Real Salary of New Doctorates
Graduate students by universities	-	-
New doctorates	-	-

The signs do not establish whether or not the matrix A is singular.

An examination of the signs of the stipend and salary coefficients suggests two hypotheses relevant to the examination of surpluses in the model. If in response to general increases in real incomes, real stipends and real doctoral salaries also rise, then there will emerge negative excess demand for graduate

students. In addition, rising real graduate stipends will lead to a surplus of graduate students and new doctorates.

This is as far as analysis of the model can be taken without discussing the adjustment of the real values of net graduate student stipends and salaries of new doctorates.

The Price Adjuster

In the late 1950's, Koopman's[9] suggested that the adjustment of prices needed to be motivated by something more than the theorist's desire that models possess stable equilibria. Arrow[10] suggested that most economic models pay considerable attention to the specification and explanation of the structure of supply and demand relationships but the adjustment of prices is generally taken for granted or left to the 'Law of Supply and Demand'.

> . . . the Law is not on the same logical level as the hypothesis underlying (the demand and supply relations). It is not explained whose decision it is to change prices in accordance with (the Law). Each individual participant in the economy is supposed to take prices as given and determine his choices as to purchases and sales accordingly; there is no-one left over who job it is to make a decision on price.[11]

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[9] T. C. Koopmans, Three Essays on the State of Economic Science (New York: McGraw Hill, 1957), p. 179.

[10] K. J. Arrow, "Toward a Theory of Price Adjustment," in M. Abramovitz et al, The Allocation of Economic Resources (Stanford, California: Stanford University Press, 1959), pp. 41-51.

[11] Ibid., p. 43.

There have been many subsequent attempts to motivate price adjustment mechanisms.[12] The problem continues to interest economic theorists.[13]

In this study universities influence the level of both of the prices involved.

The level of real graduate student stipends after tuition fees is set by universities and research administrators. Universities and departments seeking students tend to raise their offers and those who wish to limit their students tend to lower their offers. Graduate students are too fragmented and possess too little continuity in the market to be able to influence the level of stipend they receive except by their aggregate responses.[14]

The average real salary of doctorates employed by universities is set by universities, not by new doctorates. Universities seeking new staff tend to make and accept higher salaries than those able to pick and choose among applicants. Existing staff have some bargaining power relative to new staff. New doctorates are too fragmented and possess too little continuity in the market to be able to influence their first year university salaries except by their responses in aggregate

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[12] See Donald F. Gordon and Allan Hynes, "On the Theory of Price Dynamics," in Edmund S. Phelps et al, Microeconomic Foundations of Employment and Inflation Theory (New York: W. W. Norton and Company, Inc., 1970), pp. 369-93.

[13] F. H. Hahn, "Some Adjustment Problems," Econometrica. 38, 1 (January 1970), 1-17.

[14] When graduate students and new doctorates are in surplus attempts at organisation can be expected. They will succeed in negotiating because no single university can afford to lose its most mobile graduate students. When graduate students are in shortage negotiations will make no tangible difference and students will again become fragmented.

to the offers made.

Similarly, the average real salary of doctorates employed outside universities is set by the non-university employers. Employers seeking staff may bid more for new doctorates than those who have met their requirements. They may maintain the relative position of staff already employed. New doctorates are too fragmented and possess too little experience of the market to be able to influence their starting salaries except by their responses in aggregate.

University and non-university employers are affected by the actions of each other. Equilibrium is reached when both set identical salaries for identical doctorate holders in identical jobs.

If this speculation is accepted then the price adjusters in the market for higher degree holders are universities and other employers of new doctorates. They are constrained by the aggregate responses of graduate students and doctorate holders. The behaviour of price adjusters will depend upon their motivations while the aggregate responses of graduate students and doctorate holders will depend upon their motivations.

A Model of Price Adjustment

Let prices be adjusted according to the level of excess demand.

$$(4.5)\quad p(t) - p(t-1) = C\,y(t-1)$$

where C is a 2 x 2 matrix of non-negative adjustment coefficients whose relative sizes depend upon the motivation of price adjusters. C is not diagonal because universities can raise graduate stipends when they perceive excess demand in the

market for higher degree holders. Similarly, when excess demand for graduate students prevails universities might wish to raise the salaries paid to new doctorates more rapidly because their substitution opportunities are then limited. The C matrix and adjustment speeds are discussed more fully later in this chapter.

Combining (4.3) with (4.5) gives

$$(4.6)\quad p(t) - p(t-1) = C.A\, p(t-1) + C.B.\, x(t-1)$$

Under steady state conditions, so that $x(t) = x(t-1)$, it is sufficient in this model for prices to eventually return to an equilibrium position after a small displacement, that the roots of $\det (C.A. - uI) = 0$ when added to one (unity) amount to less than unity in absolute value.[15] Thus with suitable restrictions on C.A, adjustment can be made to converge on equilibrium. It is assumed that this is the case. There may however be a period during which damped oscillation about equilibrium occurs. This will occur if the roots of $\det (C.A - uI) = 0$ are imaginary.

Consider CA

$$(4.7)\quad C.A = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$$

$$= \begin{pmatrix} c_{11}a_{11} + c_{12}a_{21} & c_{11}a_{12} + c_{12}a_{22} \\ c_{21}a_{11} + c_{22}a_{21} & c_{21}a_{12} + c_{22}a_{22} \end{pmatrix}$$

The characteristic equation $\det (C.A. - uI) = 0$ is

$$(4.8)\quad (c_{11}a_{11} + c_{12}a_{21} - u)(c_{21}a_{12} + c_{22}a_{22} - u) - (c_{11}a_{12} + c_{12}a_{22})(c_{21}a_{11} + c_{22}a_{21}) = 0$$

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[15] Kelvin Lancaster, Mathematical Economics (New York: The Macmillan Company, 1968), p. 370.

Let $G = C.A.$ where $G = \begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix}$

The characteristic equation becomes

(4.9) $$(g_{11} - u)(g_{22} - u) - g_{12}g_{21} = 0 .$$

$$u^2 - (g_{11} + g_{22})u + (g_{11}g_{22} - g_{12}g_{21}) = 0$$

Its roots are:
(4.10) $$u_{1,2} = \tfrac{1}{2}(g_{11} + g_{22} \pm \sqrt{((g_{11} + g_{22})^2 - 4(g_{11}g_{22} - g_{12}g_{21}))}$$

The roots $u_{1,2}$ are imaginary if and only if

(4.11) $$(g_{11} + g_{22})^2 - 4g_{11}g_{22} + 4g_{12}g_{21} < 0$$

which may be rewritten as

(4.12) $$(g_{11} - g_{22})^2 + 4g_{12}g_{21} < 0$$

Since the squared term is positive imaginary roots are impossible if

$$g_{12}g_{21} > 0$$

That is, $g_{12}g_{21} > 0$ is sufficient for real roots, and

(4.13) $$g_{12}g_{21} = (c_{11}a_{12} + c_{12}a_{22})(c_{21}a_{11} + c_{22}a_{21})$$

$$= c_{11}a_{12}c_{21}a_{11} + c_{11}a_{12}c_{22}a_{21} + c_{12}a_{22}c_{21}a_{11} + c_{12}a_{22}c_{22}a_{21}$$

It is sufficient for $g_{12}g_{21} > 0$ that $c_{ij} > 0 \quad \forall i, j$ and $a_{ij} < 0 \quad \forall i, j$.

Table 4.2 and the assumed non-negativity of the elements of C meet these conditions.

Thus, this model will converge monotonically to equilibrium following any disturbance because the roots of the characteristic operation are real and because it has been assumed that adjustment is stable.

Recall (4.12). The market will converge on equilibrium, monotonically following a disturbance, if and only if

$$(g_{11} - g_{22})^2 + 4g_{12}g_{21} > 0$$

It is necessary but not sufficient for this condition to fail that $g_{12}g_{21} < 0$. Quantitative information about g_{ij} is required to obtain a sufficient condition for the market to follow damped oscillations.

In the following paragraphs discussion of the signs of a_{ij} is reopened. The results of that discussion are:

(1) a_{12} may be positive or negative on equally plausible arguments,

(2) a_{11} and a_{21} are most likely to be negative but could be positive under certain circumstances, and

(3) a_{22} may confidently be expected to be negative.

If any combination of a_{11}, a_{12} and a_{21} is positive, then negative terms appear in (4.13) and $g_{12}g_{21}$ may be negative.

Under steady state conditions following some disturbance it is necessary, but not sufficient, for the market to approach equilibrium via a series of damped oscillations for $g_{12}g_{21}$ to be negative. Damped oscillation could be prevented if $g_{12}g_{21}$ can be made positive.

Exceptions to the Theorem

The signs of the coefficients of A, given in Table 4.2 are crucial to this theorem. They are reconsidered in this section.

The coefficient a_{12} gives the effect of an increase in the real salary of new doctorates on the excess demand for graduate students by universities. This coefficient might be negative if tenure and other practices sufficiently restrict the universities' freedom of action for them to be unable to seek increases in their graduate enrolment at a faster rate than graduate students seek to enrol. Graduate students are relatively free to offer themselves for enrolment in response to increased starting salaries for new doctorates. The coefficient a_{12} might be positive if universities can seek to increase their graduate enrolment more rapidly than students seek to enrol. Provided graduate programmes are not at capacity this appears perfectly feasible. Thus the coefficient a_{12} could take either sign and may vary from time to time depending upon the capacity utilisation of graduate schools.

The coefficient a_{11} represents the effect on the excess demand for graduate students by universities of increases in the real stipend paid to graduate students. Universities are expected to react to increases by substituting new doctorates for graduate students. Stipends are expected to encourage enrolment because they enter lifetime income directly. Thus a_{11} is expected to be negative. On the other hand, increases in real net graduate stipends, if they are tied to research grants from outside universities, might lead to universities vigorously increasing the number of graduate students they seek to enroll. Similarly external student assistance agencies might raise and lower student stipends at the same time as they raise and lower the numbers of students they support. In either case the coefficient a_{11} could be positive.

Turning to the coefficient a_{21}, which represents the effect of

increasing real graduate stipends on excess demand for new doctorates, it can be argued that increased stipends stimulate graduations and this effect outweighs any stimulation of demand for new doctorates through substitution effects by universities. In this case a_{21} would be negative. Alternatively it is possible that rising stipends might reduce graduations by enabling students to prolong their stays at university in which case a_{21} would be positive. Casual observation suggests that students will leave universities with unfinished degrees when a labour market opportunity presents itself. According to Freeman students do not prolong their university enrolment in response to stipends.

The coefficient a_{22} represents the effect of increasing doctoral salaries on excess demand for new doctorates. When the real salaries of new doctorates rise, provided that other things remain the same, it is expected that employers will reduce their demand for new doctorates by substituting other cheaper input, and that students will be encouraged to graduate early and to seek employment in the Canadian market. Some of the demand will be alleviated by students who take jobs before graduating. The coefficient a_{22} will be negative under these circumstances. When a large shortage of new doctorates emerges this situation could be reversed temporarily. If employers and students expect further rapid increases in the salaries of new doctorates and if they believe that life time income of doctorates is determined by starting salary, then excess demand will rise. Employers will attempt to hire their future requirements at present salary scales while students will delay graduation and migrate to Canada in anticipation of increased lifetime incomes. Then a_{22} would be

positive.

When universities and other employers face rising salaries for new doctorate holders their immediate reaction may be to seek a faster rate of output of new doctorate holders.[16] If graduate enrolment can be rapidly expanded, as is the case when external stipend sources are available, then excess demand for graduate students will expand when doctoral salaries rise. The reaction of universities to rising stipends depends very much upon their implication for university expenditure. If the stipend will be paid from external or automatically available funds there will be little to prevent the demand for students expanding relative to the supply. If, in addition, additional graduate students attract additional research grants, universities would have reason to seek more students than the higher stipend attracted. Finally rising graduate stipends might be a signal to universities from funding agents that they wished to encourage a rapid increase in graduate enrolment.

The coefficient a_{11} and a_{12} might more confidently be expected to be negative if graduate stipends had to be paid by universities at the cost of foregoing some other expenditure. This policy might prevent stipends and salaries from over adjusting during times of shortage and thus prevent the emergence of surplus when stipends and salaries cannot later be lowered. However such a policy would not eliminate a surplus once it had commenced.

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[16] Some evidence of this is contained in the reaction of the Canadian Association of Graduate Schools to declining rates of increase in enrolments in Ph.D. programs in science. "...Canadian employers in the field of applied and life sciences may be confronted with a shortage of personnel with graduate degrees in the not too distant future." 1973 Statistical Report, op.cit., p. 1

The C Matrix

The adjustment speed matrix C has been chosen to have non-zero off-diagonal elements. This is not usual practice in discussions of adjustment speeds. The purpose of this is to make use of the assertion that universities have a price adjusting role.

If universities perceive excess demand in the market for new doctorates they will seek to raise graduate student stipends in order to reduce the likely increases in the salaries of new doctorates.[17] A case in which declining rates of growth of enrolment in doctoral programs prompted expectations of shortage in the market for new doctorates has already been noted.[18] This suggests that c_{12} is positive.

The speed of adjustment of the salaries of new doctorates in response to excess demand for graduate students is c_{21}. An increase in the salary of new doctorates would allow new doctorates to be substituted for graduate students as well as stimulating the supply of graduate students. Although any effect would presumably be positive, in this case the argument for an effect is less plausible because universities have more direct options which they can undertake. For instance an increase in graduate stipends (c_{11}) or a decline in graduate

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[17] If the university budget setting process includes a review of the labour market by government funding agencies, universities might feel compelled to vary graduate stipends to reduce surpluses or shortages of higher degree holders. This would support the contention that c_{12} is positive.

[18] Canadian Association of Graduate Schools, 1973 Statistical Report, p. i.

admissions standards will have immediate effects. For the purposes of the model it has been assumed that grade point averages vary only in the long run.[19]

Non-zero off-diagonal elements of C do not necessarily introduce the possibility of damped oscillations about equilibrium. This can be avoided by specifying that the characteristic roots of the matrix C should be real and less than unity in absolute value. Any square matrix having distinct characteristic roots can be diagonalized by a suitable transformation.[20] In terms of our model this transformation is equivalent to changing units. Thus specifying C with non-zero off-diagonal elements should not lead to special difficulties.

In this instance it is possible to show just what difference non-zero off-diagonal elements in the matrix C have made to the results.

Let $c_{12} = c_{21} = 0$ and rewrite (4.12).

Inequality 4.12 may be rewritten as

$$(4.14) \qquad (c_{11}a_{11} + c_{12}a_{21} - c_{21}a_{12} - c_{22}a_{22})^2 + 4(c_{11}a_{12} + c_{12}a_{22})(c_{21}a_{11} + c_{22}a_{21}) < 0$$

The sufficient condition for equilibrium to be approached via damped oscillation is then:

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[19]The lowering of grade point averages would be resisted under the research maximization hypothesis because the average research productivity of graduate students would fall. Better students might no longer consider enrolling at a univeristy with declining standards.

[20]See Lancaster, Mathematical Economics, op. cit., pp. 286-289. The diagonal matrix will consist of the characteristic roots.

$$(4.15) \qquad (c_{11}a_{11} - c_{22}a_{22})^2 + 4(c_{11}a_{12}c_{22}a_{21}) < 0$$

This condition would hold when a_{12} and a_{21} do not have the same sign while c_{11} and c_{22} do. Therefore, the structural coefficients can satisfy the necessary conditions for an overadjustment without aid from the adjustment coefficients. However, if the off-diagonal adjustment coefficients are non-zero, then an additional structural parameter, a_{11}, becomes relevant to adjustment.

Rigidities in Adjustment

The model presented in this chapter is capable of generating a temporary surplus under steady-state conditions, following a shock which disturbs the model in any way whatever. Provided the structural parameters are of appropriate magnitudes the model will exhibit damped oscillations about equilibrium.

The discussions of chapters 2 and 3 suggest that a model capable of explaining persistent surplus may be required. This behaviour can be obtained by imposing inflexibility of stipends and salaries.

In particular one might argue that real graduate student stipends and real salaries of new doctorates may be inflexible downwards. The reasoning depends upon the assumption that universities seek to maximize their scholarly research output. In addition it can be assumed that the most productive researchers are also the most mobile. This means that if real stipends or real salaries are allowed to decline, the most valued graduate students and new doctorates will leave the university. To some extent the non-academic sector of

the new doctorate labour market will find it necessary to follow the behaviour of the universities in order to retain staff.

Whenever either graduate stipends or salaries of new doctorates fall against their lower bound the free variable follows a different but still determined path.[21]

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[21] This can be demonstrated by expressing (4.5) in elementary form:

(4.16) $$\begin{pmatrix} p_1(t) - p_1(t-1) \\ p_2(t) - p_2(t-1) \end{pmatrix} = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} y_1(t-1) \\ y_2(t-1) \end{pmatrix}$$

Where $p_1(t) - p_2(t-1) \geqslant 0$ and $p_2(t) - p_2(t-1) \geqslant 0$

Suppose that p_1 (graduate stipends) is against its lower bound because:

$$c_{11}\, y_1(t-1) + c_{12}\, y_2(t-1) \leqslant 0.$$

The starting salaries of new doctorates continue to adjust according to:

(4.17) $$p_2(t) - p_2(t-1) = c_{21}\, y_1(t-1) + c_{22}\, y_2(t-1)$$

and the paths of $y_1(t)$ and $y_2(t)$ continue to be determined by:

$$y_1(t) = a_{11}\, p_1(t) + a_{12}\, p_2(t) + \sum_{i=1}^{k} b_{1i}\, x_i(t)$$

$$y_2(t) = a_{21}\, p_1(t) + a_{22} p_2(t) + \sum_{i=1}^{k} b_{2i}\, x_i(t)$$

Where $p_1(t) - p_1(t-1)$ and $p_2(t)$ is determined by (4.17). The solution is recursive.

Whenever the real salaries of new doctorates fall against their lower bound the path of all other variables are similarly determined. This would occur whenever:

$$c_{21}\, y_1(t-1) + c_{22}\, y_2(t-1) \leqslant 0.$$

With the addition of these regidities the model will display a pattern of behaviour which may be described as follows:

(1) Shortages in either market will lead to rising stipends and salaries. If the structural parameters have appropriate signs, the stipends and/or salaries will rise above their equilibrium level and become 'stuck' there. Otherwise stipends and/or salaries will converge directly towards equilibrium.

(2) Surpluses in either market will tend to persist until some exogenous change converts them to shortages.

During the period of surplus some quantity adjustments will occur which will tend to shift the exogenous structure of the demand and supply functions and result in time paths tending not to be repeated. A surplus of graduate students seeking enrolment will result in rising acceptance standards at universities and in potential graduate students turning away from study because they observe the surplus (in either market). Similarly, in reaction to observed surpluses graduate students will drop out and some new doctorates will never seek work relating to their training. These quantity adjustments will need to be so large that stipends and salaries of new doctorates have no need to fall.

By adding rigidities to adjustment and identifying the kinds of quantity adjustments which are available to accommodate these rigidities it is possible to obtain a model of persistent shortage or surplus.

Conclusion

This chapter has presented a model of the market for higher degree holders in which universities have an important role. Two of the possible ways in which surpluses or shortages could be observed in this model are discussed. Exogenous variations could also produce any pattern of behaviour desired.

Certain structural parameters of the model are important if it is desired that equilibrium be achieved without experiencing a series of oscillations about it. This may be desirable if inflexibilities against downward changes in stipends or salaries are expected.

SUMMARY, RECOMMENDATIONS AND FURTHER RESEARCH

Summary

This thesis has attempted to explain surpluses of higher degree holders in Canada by reviewing the literature on labour market shortages and surpluses, setting out the evidence for surplus and shortage in Canada, examining trends and patterns in Canadian graduate education and, finally, incorporating the views obtained into a model of the relationship between the market for higher degree holders and the graduate education system.

Blank and Stigler provide a test for surplus or shortage which presumes market clearing equilibrium. Measurement of surplus or shortage is not possible in any model reviewed. Arrow and Capron's model of dynamic shortages is the most appealing explanation of the episodes of shortage in this market, but is less attractive as an explanation of surplus and provides no empirical test. Arrow and Capron avoid the instantaneous equilibrium analysis of Blank and Stigler by providing an account of the adjustment process from the view point of employers of engineers. No other scholars appear to have taken up their challenge by extending the analysis of price adjustment to include other agents such as universities or by explaining the path of adjustment. The available accounts of the doctoral labour market treat the university as a passive agent and obtain dynamic effect from technological or demographic change. The study of markets in persistent disequilibrium has not yet provided many general results but provides

some insights which illuminate previous empirical work.

The available data suggest that episodes of shortage and surplus have characterized the Canadian market for higher degree holders since the turn of the century. Despite the belief that higher degree holders can readily find work in substitution for less schooled labour, unemployment of doctorate holders was being reported in the early 1970's. At this time doctoral graduations had reached record levels relative to the total teaching staff at Canadian universities and relative to the university age cohort in the Canadian population.[1] In the early 1970's the salaries of university staff and the starting salaries of new doctoral and master's degree holders fell sharply relative to average weekly wages in manufacturing. This can be interpreted as evidence of the emergence of a surplus of higher degree holders on the Canadian labour market. This interpretation rests on the assumption that all relative price adjustments take place only in order to clear the market making them a reliable guide to the sign of excess demand. This is the basis of the test for surplus suggested by Blank and Stigler.

The conceptual framework of an aggregate production function was used to organize the data on higher education in Canada. Output was defined as educational resources and was measured by undergraduate enrolment. Graduate students were specified to be inputs which have a non-zero elasticity of substitution with teaching staff. Graduate students have been asserted to have marginal products for universities which exceed their marginal costs and warrant a

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[1] Foreign students will bias this statistic upwards.

factor payment.

Some evidence was cited regarding the productivity of graduate students. The influx of World War II veterans to Canadian universities led to a rapid increase in enrolments which was accommodated by using graduate students as teaching assistants. It has been suggested that this change in practice led to a permanent shift in the proportion of graduate students relative to teaching staff at Canadian universities. A review of operating revenues showed that revenue from governments has displaced fees and philanthropy to constitute 70% of university operating funds. University operating revenues exceeded 1% of Gross National Product at market prices in the late 1960's, a proportion which had quadrupled since 1930.

Over the period 1920 to 1968, the resources of teaching staff and graduate students which Canadian universities have employed appear to have grown faster than the number of undergraduate students themselves. Capital employed has grown at slower rates over the whole period, but since World War II it has outstripped undergraduate enrolment. Applying these data to an aggregate production function framework suggests that universities have been becoming less 'productive' over time.[2]

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[2]The aggregate production function framework has limitations, particularly when it is applied to education. Several possible explanations of declining apparent productivity are given in Chapter 3. As suggested in Chapter 4 universities also use resources for research and other purposes not allowed for in this test. Using different methods Hettich also concludes that university productivity has been declining. See Walter Hettich, Expenditures Output and Productivity in Canadian University Education, Cat. No. EC22-2/14 (Ottawa: Information Canada, 1971).

Total graduate enrolment grew particularly rapidly from 1920 to 1933 and from 1943 to 1973. In the latter period graduate students were used to relieve the instructional and clerical tasks of teaching staff. By 1956, graduate students were receiving considerable net income as a result of undertaking studies in Canada. They were receiving funds on far more liberal terms than were undergraduates. Graduate study became a readily financed haven from the labour market for those baccalaureate holders who were able to achieve entry. Universities have been bidding for graduate students using stipend support, which is often provided to universities for that purpose, relieving university budgets of this expenditure.

A model of the linkages between the market for graduate students and the market for higher degree holders has been presented. The model highlights the capacity of all agents to change their behaviour. In particular universities have been provided with a simple motivational hypothesis; namely that they maximize their output of scholarly research subject to their responsibilities to provide a satisfactory volume of educational resources and to satisfy budget and other resource constraints. In other words, in this model research plays a similar role for providers of educational resources as profits do for manufacturers of commodities.

Universities have been assumed to make substitutions between graduate students and teaching staff in order to obtain a maximum output of scholarly research, subject to the constraints mentioned. This behaviour determines the demand for graduate students and affects the demand for new doctorates in the model.

The supply of graduate students to universities and the supply of new doctorates to the Canadian labour market have also been included in the model.

Short run adjustment in this model has been made dependent upon the behaviour of real graduate student stipends (net of fees) and real salaries of new doctorates in the labour market.

The behaviour of the model was examined under steady state conditions, assuming a stable adjustment mechanism. It was shown that if the excess demands for graduate students and for new doctorates are declining functions of both stipends and salaries, then the market will converge monotonically to market clearing equilibrium following any disturbance. If for some reason excess demands for one or both of graduate students and new doctorates rise when either stipends or salaries rise, then it is possible that following any disturbance the model will converge to equilibrium through a series of damped oscillations about equilibrium.

The model has been constructed to allow excess demands in one market to affect price adjustment in the other. Although this is unusual it does not itself determine the results obtained. It does make it possible for a wider range of structural parameters to affect the adjustment path. The non-zero off-diagonal elements in the adjustment matrix formalize the interest of the university in both markets.

Persistent disequilibrium can only occur in this model if it is prevented from adjusting. Lower bounds to real stipends or real salaries can produce persistent surpluses. These rigidities are consistent with the behavioural model

suggested because highly valued research students and staff would be most likely to be lost to any university at which stipends or salaries were allowed to fall. Prior agreement among all universities to simultaneous equal adjustments appears unlikely.

Throughout this study it has been assumed that the adjustment mechanism of the market is stable. The central role in adjusting the market has been assigned to universities but no clear motivation for the university to seek to clear markets has been provided. Indeed surpluses of new doctorates and of graduate students would be highly desirable to an institution devoted to getting research done. As Peitchinis has put it:

> . . . the expansive nature of research activity permits the absorption of unlimited quantities of manpower.[3]

In practice, one assumes, the budget setting process provides the necessary constraint.

The Model as a Simplification of Events

The model is capable of depicting the events reflected in the available data. For the period from about 1957 to 1965 the annual increase in the demand for new doctorates in Canada was sufficient to keep the market in a state of dynamic shortage, as described by Arrow and Capron. The adjustment of the

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[3] Stephen G. Peitchinis, Financing Post-Secondary Education in Canada, A Report Commissioned by The Council of Ministers of Education of Canada, Calgary, July 1971, p. 320.

market was cyclical however, and when it became possible to achieve equilibrium, from 1965 onwards, the market overshot and a surplus emerged in 1968. The persistence of this surplus may be explained as the result of continued reductions in demand for new doctorates, or of downward rigidity of graduate stipends or of the slow cycles in the adjustment path. The sharpness of the shift to surplus suggests that adjustment is relatively rapid and that a slow cycles explanation cannot be supported.

For the period 1920 to 1957 it may be that graduate students were supplied to Canadian universities from domestic sources and real stipends were not sticky downwards. It is suggested that the immediate post-war boom in undergraduate enrolments raised the importance of a steady supply of graduate students to Canadian universities. The record does not clearly establish whether surpluses persisted during this time.

The model suggested above is an extension of that of Arrow and Capron. They have shown that surpluses and shortages can be explained without abandoning stable adjustment mechanisms. They rely on lagged responses of the adjustment mechanism and urge consideration of adjustment behaviour. The model suggested here illustrates how surpluses and shortages may arise from structural sources. It also suggests that it is reasonable to use the adjustment mechanism to interrelate markets and shows that this can result in additional structural parameters becoming relevant to the adjustment path. Because it identifies parameters which are related to the adjustment path it is possible to use it to formulate some broad rules for policy with regard to the effects of policy on these parameters.

Recommendations for Policy

Policy with regard to this market must take into account a variety of issues not discussed in this thesis. For instance these include the level of access to undergraduate education to be achieved and the level and distribution of research activity to be sustained in Canada.

Governments provide more than 70% of the operating revenues of universities. Funding policies may explain much of the behaviour of universities. The model presented suggests some potentially important effects. In particular there may exist a relationship between funding policies and the structural parameters identified in Chapter 4. For instance, the size of the budget attracted to a university by an additional graduate student will affect the behaviour of a university whenever a response to increased stipends or to increased doctoral salaries is required. A high value may encourage the substitution of graduate students for staff and make graduate student demand insensitive to increases in stipends.

Whenever a change in the method of financing universities or students is considered it would be worth considering the effects on the signs of the elements of the A matrix. A change in methods which may result in excess demand for graduate students or for new doctorates increasing in response to an increase in real graduate stipends or real salaries of new doctorates should be avoided.

In the short run, because the doctorates have already graduated there is little that can be done other than to assist them in job search. Some gains might be

made by publicising data about the market to graduate students, thus counteracting a tendency to optimism among them and their advisers and possibly accelerating the adjustment process.

It may also be possible to overcome the problem by considering new institutional forms. The rigidities suggested in the last chapter are based on the research orientation postulated for universities. They can have the effects suggested because the research institutions are also teaching institutions. Some separation of these functions might enable Canada to attract and retain her share of top flight researchers without at the same time being compelled to frustrate some of the most capable of her young.

Topics for Further Research

Some questions for further research remain. Testing of the model must await the availability of flow data on graduate students, and more reliable graduate stipend data. In addition standardized data on the quality of graduate students at Canadian universities are required.

The relationships between information imperfections, job search and market adjustment could be fruitfully explored. Better information might speed adjustment and reduce the time spans over which surplus or shortage persist.

Further work on university behaviour, on the externalities between research and teaching and on the production function for educational resources can also be suggested. These studies would extend knowledge of the rigidities in adjustment and perhaps suggest alternative, less rigid, structures for teaching

and research.

The understanding of adjustment and of the constraints under which it operates might be fruitfully analysed using game theory. Universities, students, graduates and non-academic employers can be viewed as participants in a game. A variety of results depending upon the particular circumstances could be expected to provide a number of insights into the adjustment problems of this market.

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APPENDIX A

DATA

This appendix presents some of the major data sources used in this study. The discussion concerns only the description of the data, some commentary on major omissions, and the considerable statistical drawbacks in the available material.

The order of presentation is determined by the general order of attack in the study. Thus the discussion begins with data concerning graduate students, and continues to universities. Other sources of supply and demand for graduate degree holders have not been treated here. None of the sections can make any claim to completeness, but for some of the data this may be the first collection from the scattered original sources.

Definitions

Unfortunately, no definitions of part-time enrolment, full-time enrolment or of the licence degree are published with the data on them. This may be a matter left up to the individual reporting universities. The meaning of these data is left in some doubt.

The distinction between part-time and full-time enrolment appears to be based upon workload. "A full-time student is defined as a student enrolled in

classes amounting to at least 75 percent of a recognized full workload for an academic year."[1] In the case of graduate students, who have completed their course work, the distinction rests upon attendance on the campus. Graduate students who maintain their registration, but do not attend, are classified as part-time. Many of these may, in fact, be already employed.

The licence degree of French language universities has been handled inconsistently in the data sources. Up until 1967-68 they were counted as master's degrees. From 1968-69, they have been reported with bachelor's degrees. The licence is a form of professional qualification. A recent reclassification classes most licences as bachelor's degrees.[2] "Graduate students are students registered in courses leading to degrees or diplomas beyond the Bachelor's or first professional degree."[3] Some master's degrees, such as the Master of Social Work, are sometimes given as a first degree. Students enrolled in such courses are reported as undergraduates, at least from 1962-63. Some other master's degrees may be obtained after a prior degree in another field. In education and theology these students are classed as undergraduates, while in

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[1] Z. E. Zsigmond and C. J. Wenaas, Enrolment in Educational Institutions by Province: 1951-52 to 1980-81, Economic Council of Canada, Staff Study No. 25 (Ottawa: Queen's Printer for Canada, 1970) p. 266. This definition is less appropriate for graduate students.

[2] See below, in the discussion of graduations data.

[3] Zsigmond and Wenaas, op. cit., p. 266.

business they are classed as graduate students. Prior to 1962-63 reporting practices included some graduate students among undergraduates.

"Undergraduate university enrolment includes students in courses leading to undergraduate diplomas or to a bachelor's or a first professional degree."[4] As noted above, the reporting practice has varied.

Graduate Students: Enrolment

Table A-1 presents fifty-three years of graduate enrolment in Canada. It shows that from 1919-20 to 1932-33 graduate enrolment in Canada rose by a factor of a little over four. Curiously, although there were slight declines in enrolment between 1924-25 and 1925-26 and between 1927-28 and 1928-29, graduate enrolment rose at rates in excess of 10% during the decline of the Canadian reference cycle associated with the great depression, from April 1929 to March 1933.[5] In the succeeding two years a decline of approximately 10% was recorded, followed by a smaller two-year rise, a one-year rise, leading to a small increase up to the year 1939-40.

The second world war may be associated with the decline in graduate enrolment in the years 1939-40 to 1942-43.[6] The mildness of the intervening fluctuations is emphasized by the fact that total graduate enrolment in Canada in

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[4] Ibid., p. 266.

[5] Derek, A. White, Business Cycles in Canada, Staff Study No. 17, Economic Council of Canada (Ottawa: Queen's Printer, 1967), p. 236.

[6] See chapter 3 n.19 for a fuller discussion of this point.

TABLE A-1

TOTAL OF FULL-TIME AND PART-TIME GRADUATE STUDENTS REGISTERED IN THE FALL OF THE YEAR 1919 - 20 TO 1972 - 73

Year	Enrolment	Year	Enrolment	Year	Enrolment
1919-20	383	1937-38	1540	1955-56	5013
21	423	39	1550	57	5125
22	558	40	1601	58	5847
23	714	41	1569	59	6517
24	851	42	1406	60	7642
25	873	43	1227	1960-61	9120
26	846	44	1392	62	10327
27	929	45	1689	63[a]	13787
28	1039	46	2870	64	17631
1928-29	1010	47	3674	65	21065
30	1137	48	4139	66	24920
31	1350	49	4857	67	29834
32	1569	1949-50	5262	68	34883
33	1698	51	4559	69	36604
34	1687	52	4302	1969-70	43950
35	1533	53	4387	71[b]	47246
36	1586	54	4709	72	50950
37	1635	55	4854	73	55600

[a]Prior to 1962-63 some graduate enrolment was included in undergraduate enrolment in social work and theology. Therefore data from 1962-63 onwards is not strictly comparable with those for earlier years.

[b]Data from 1970-71 onwards is preliminary only.

Source:

1919-20 to 1961-62: Canada, Dominion Bureau of Statistics, Survey of Higher Education: 1961-62, Cat. No. 81-211 (Ottawa: Queen's Printer and Controller of Stationery, 1964).

1962-63 to 1969-70: Canada, Dominion Bureau of Statistics, Survey of Higher Education, Part 1: Fall Enrolment in Universities and Colleges: various years, Cat. No. 81-204 (Ottawa: Queen's Printer, various years).

1970-71 to 1972-73: Canada, Dominion Bureau of Statistics or Statistics Canada, Advance Statistics of Education, various years, Cat. No. 81-220 (Ottawa: Queen's Printer, various years).

1940-41 was exactly the same as it hadbeen nine years earlier, in 1931-32. From 1942-43 to 1972-73 graduate enrolment grew by a factor of 45 and this growth was interrupted only by a sharp decline of about 20% over the years 1949-50 to 1951-52.

The longest sustained decline in absolute numbers was in the three academic years roughly coinciding with the second world war. The longest sustained growth in absolute numbers was in the twenty one years after 1951-52.

The division of the period into three emphasizes, perhaps unduly, the unsettled nature of graduate enrolment from the great depression years, 1932-33, to the period of the second world war, 1942-43. Aside from that period, growth rates in excess of 10% have been the most common observation. It is worth emphasizing that history does provide examples of low rates of growth in graduate enrolment.

As an overview Table A-2 presents the results of an analysis of growth rates in the data in Table A-1. The slope coefficients of these regressions are estimates of the constant annual rate of growth which yields a best least squares fit over the time period indicated. The fitted function was $\ln G_t = a + bt$ where G_t = graduate enrolment in year t, t = year (expressed as last two digits), $a = \ln A$, and ln is the logarithm to base e.

This procedure was also applied to data on full-time undergraduate enrolment, the civilian labour force, and the population between the ages of 20 and 29 years.

The analysis of full-time undergraduate enrolment data is presented later in this appendix. The estimated growth rates were 4.9% for the period 1919-20

TABLE A-2

REGRESSION ANALYSIS FOR GROWTH RATES
IN GRADUATE ENROLMENT IN CANADA
1919-20 TO 1972-73

Period	Observations	Estimated Growth Rate	Constant	r Coefficient of Correlation ($\ln G_t$ to t)	σ Standard Error of Estimate
1919-20 to 1972-73	54	.083 (.003)	4.342 (.158)	.963	.368
1919-20 to 1932-33	14	.102 (.008)	4.072 (.215)	.965	.121
1932-33 to 1942-43	11	-.021 (.006)	8.142 (.228)	-.762	.063
1942-43 to 1972-73	31	.117 (.006)	2.286 (.325)	.969	.276

(figures in parentheses are standard errors)

Source: TABLE A-1.

to 1972-73, 3.1% for 1919-20 to 1932-33, 0.9% for 1932-33 to 1942-43, and 6.8% for 1942-43 to 1972-73. Graduate enrolment has grown faster or contracted faster than undergraduate enrolment for the periods selected. The general pattern of behaviour has been similar.

The civilian labour force consists of those individuals 14 years of age and over who did some work, had jobs but did not work, or did not have jobs and were seeking work in the survey period and who were not inmates of institutions, Indians on reservations, members of the armed forces, or residents of Yukon and Northwest Territories. The data used are estimates for June of each year.[7]

The analysis of civilian labour force data showed that for the period 1921 to 1971 the estimated growth rate was 1.8%. For the period 1921-1932 the growth rate was 2.3%, for 1932-1942 it was 0.8%, and for the period 1942 to 1971 the estimate is 2.4%. Thus the general pattern of behaviour observed for graduate and undergraduate enrolment was repeated in the civilian labour force. For the first and last sub-periods, above average growth rates were recorded in

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[7]Sources are as follows: Canada, Dominion Bureau of Statistics, Canadian Labour Force Estimates, 1931-45, Reference Paper No. 23. (Revised), Cat. No. 71-501, (Ottawa: Queen's Printer and Controller of Stationery, 1957), for 1921-1945; _____, The Labour Force, November 1945 - July 1958, Reference Paper No. 58, 1958 Revision, Cat. No. 71-502, (Ottawa, Queen's Printer and Controller of Stationery, 1958), for 1946-1956; and Canada, Statistics Canada, Seasonally Adjusted Labour Force Statistics, January 1953-December 1971 Cat. No. 71-201 (Ottawa: Information Canada, 1972) for 1957 to 1971.

graduate enrolment and in the civilian labour force, whereas undergraduate enrolment grew faster than average only in the last sub-period.

Population estimates for the age group from 20 to 29 years do not show similar patterns of growth to enrolment data.[8] Estimated growth rates declined from 2.1% in the first period, 1921-32, to 1.4% in the second two periods, 1932-42, and 1942-70. It would seem that the variation in the population aged 20 to 29 cannot explain all of the variation in graduate (or undergraduate) enrolment. Participation rates have varied.[9]

It is not possible to obtain reliable data for annual new graduate enrolment in Canada. Also the separation of part-time from full-time graduate enrolment is not available before 1962-63. This is unfortunate because many part-time graduate students may be working in junior academic posts while completing their theses. For later years it becomes possible to examine enrolment by faculty, but those faculties are inconsistently chosen and not very informative within the areas of arts and science.

The statistical drawbacks of these data are mentioned in the notes to

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[8] This age group was chosen arbitrarily, to correspond with the age group within which graduate students fall, and with published age group data. The published data are arranged in five-year intervals. See Canada, Dominion Bureau of Statistics, Population by Sex and Age, 1921-1966 Cat. No. 91-511 (Ottawa: Dominion Bureau of Statistics, 1968), and _____, Estimated Population by Sex and Age Groups, Canada and Provinces, various years, Cat. No. 91-202 (Ottawa: Dominion Bureau of Statistics, various years).

[9] See Chapter 3.

Table A-1. Specifically starting in 1962-63 there was a change in the social work and theology categories, bringing them from undergraduate to graduate classifications. For totals data this change is probably not important because total enrolment in those categories was, and remains, a small percentage of total enrolment.

These data may have been affected by the changes in financial arrangements for higher education during these years and by changes in the age and education composition of the Canadian population. Available studies have not compared these data with population data for holders of bachelors or first professional degrees within appropriate age groups.[10]

For the years 1961-62 to 1969-70, Table A-3 presents full-time and part-time graduate enrolment by faculty in Canada.

The faculties used in grouping these data are not consistent across universities. Every university has been allowed to aggregate subjects of specialization into faculties as it has seen fit. Thus some of the variation reported may be due to universities revising their classifications. Similarly, national growth of enrolment in subject areas which are reported under a variety of faculties (e.g. psychology) may be hidden by being dispersed into a number of faculties.

Some comments can, however, be made. Table A-4 summarizes these data for selected faculties in 1962-63 and 1969-70.

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[10] Zsigmond and Wenaas, Enrolment in Educational Institutions, and Illing and Zsigmond, Enrolment in Schools and Universities.

TABLE A-3

FULL-TIME AND PART-TIME GRADUATE ENROLMENT
BY FACULTY, CANADA, 1961-62 to 1969-70.

Faculty	Type	1961-62	62-63	63-64	64-65	65-66	66-67	67-68	68-69	69-70
Arts[a]	Full	2059	2332	3878	5127	6777	7821	9738	9092	10309
	Part	n.a.	1230	1614	2101	2346	4011	4445	3627	4498
Pure Science[a]	Full	2040	2266	2471	3286	4059	4567	5426	6200	7105
	Part	n.a.	467	317	371	486	603	688	737	873
Total Arts & Sci.	Full[b]	4144	4598	6349	8413	10836	12388	15164	15292	17625
	Part[c]	n.a.	1697	1931	2472	2832	4614	5133	4364	5411
Agriculture	Full	307	334	424	517	504	454	662	921	652
	Part	n.a.	51	70	80	73	115	82	123	106
Architecture	Full	32	48	18	30	46	80	48	100	115
	Part	n.a.	1	2	5	8	13	25	26	32
Commerce	Full	494	573[d]	762	880	1016	1227	1538	1634	1870
	Part	n.a.	1023	1440	1190	1292	1581	1098	1416	1588
Dentistry	Full	33	33	39	49	55	70	67	100	91
	Part	n.a.	3	6	10	16	10	15	6	14
Education[e]	Full	345	507	434	575	829	1012	1184	1601	1745
	Part	n.a.	1255	1620	1742	1963	2413	2040	2404	3530

TABLE A-3 (Continued)

Faculty	Type	1961-62	62-63	63-64	64-65	65-66	66-67	67-68	68-69	69-70
Engineering	Full	660	867	1129	1376	1723	2031	2585	3023	3217
	Part	n.a.	718	835	979	731	496	992	814	1135
Forestry	Full	63	54	70	63	102	116	125	145	162
	Part	n.a.	4	21	14	29	29	52	61	57
Household Sci.	Full	1	4	14	15	15	20	38	44	73
	Part	n.a.	1	2	3	7	7	9	7	34
Law	Full	97	79	79	127	63	104	134	126	152
	Part	n.a.	51	67	59	60	53	51	77	99
Library Sci.	Full	-	-	6	1	1	6	-	5	341
	Part	n.a.	23	23	30	37	37	55	86	169
Medicine[f]	Full	750	560	898	789	871	1018	1334	1301	1565
	Part	n.a.	29	77	221	186	141	124	142	149
Music	Full	29	11	55	48	44	58	76	96	113
	Part	n.a.	16	59	48	46	64	79	78	82
Nursing	Full	68	49	20	23	28	27	90	64	47
	Part	n.a.	32	13	7	1	14	2	10	11

TABLE A-3 (Continued)

Faculty	Type	1961-62	62-63	63-64	64-65	65-66	66-67	67-68	68-69	69-70
Pharmacy	Full	18	56	45	65	72	78	77	94	105
	Part	n.a.	6	14	11	4	6	7	13	14
Physical Educ. & Health Educ.	Full	6	27	31	34	45	56	69	90	122
	Part	n.a.	3	2	9	11	11	20	40	58
Physiotherapy & Occupational.	Full	30	27	37	44	48	61	54	50	45
	Part	n.a.	-	-	-	-	-	-	1	-
Social Work[g]	Full	184[h]	97	212	218	264	126	136	270	978
	Part	n.a.	30	14	28	35	8	63	152	152
Theology[k]	Full	-[m]	297	147	137	219	298	277	334	321
	Part	n.a.	136	116	128	122	165	125	224	191
Veterinary Sci.	Full	15	13	23	21	29	39	48	56	92
	Part	n.a.	-	-	-	7	14	20	17	19
Others (Including Unclassified)	Full	71	202	341	372	386	450	481	774	800
	Part	n.a.	272	186	232	264	320	704	423	868
Total[n] (less duplicates)	Full	7347	8436	11133	13797	17196	19719	24187	26120	30231
	Part	n.a.	5351	6498	7268	7724	10111	10696	10484	13719

TABLE A-3 (Continued)

[a]Some institutions include Pure Science enrolment in Arts.

[b]Unclassified Arts and Pure Science full-time enrolment was reported as follows: 1961-62, 45; 1969-70, 211.

[c]Unclassified Arts and Pure Science part-time enrolment was reported as follows: 1969-70, 40.

[d]Excludes 327 reported elsewhere for the same year.

[e]Students with a prior degree in another field were classed as undergraduates, while students with a prior degree in the same field were classed as graduate students.

[f]Interns at the University of Toronto were reported as full-time graduate students prior to 1962-63, but not thereafter. Omitted were 217 in 1962-63, 237 in 1963-64, 209 in 1964-65.

[g]Masters degree students attending institutions offering only the Master of Social Work (MSW) were included in undergraduate enrolment. Some graduate students are included in undergraduate enrolment prior to 1962-63.

[h]Incomplete

[k]Students with a prior degree in another field were classed as undergraduates, while students with a prior degree in the same field were classed as graduate students. Some graduate students are included in undergraduate enrolment prior to 1962-63. Excludes Religious Education, where available. Religious Education was included in Others.

TABLE A-3 (Continued)

[m] All reported as undergraduates.

[n] Not complete prior to 1962-63.

Source: Canada, Dominion Bureau of Statistics, Survey of Higher Education, Part I: Fall Enrolment in Universities and Colleges, 1961 to 1969-70, Cat. No. 81-204 (Ottawa: Queen's Printer (various years)). In the 1970-71 issue the form in which these data are published was changed so that comparable data cannot be constructed from published sources beyond 1969-70.

TABLE A-4

FULL-TIME AND PART-TIME GRADUATE ENROLMENT IN 1962-63 AND 1969-70 FOR SELECTED FACULTIES

Faculty	Enrolment Type	Year 1962-63		Year 1969-70	Ratio 1969-70 / 1962-63	
Arts	Full-Time	2332		10309	4.42	
	Part-Time	1230		4498	3.66	
	Total	3562		14807	4.16	
Science	Full-Time	2266		7105	3.14	
	Part-Time	467		873	1.87	
	Total	2733		7978	2.92	
Arts and Science	Full-Time	4598		17625[b]	3.83	
	Part-Time	1697		5411[b]	3.19	
	Total	6295		23036[b]	3.66	
Agriculture	Full-Time	334		652	1.95	
	Part-Time	51		106	2.08	
	Total	385		758	1.97	
Business	Full-Time	573		1870	3.26	
	Part-Time	1023	(1350)[a]	1588	1.55	(1.18)[a]
	Total	1596	(1923)[a]	3458	2.17	(1.80)[a]
Education	Full-Time	507		1745	3.44	
	Part-Time	1255		3530	2.81	
	Total	1762		5275	2.99	
Engineering	Full-Time	867		3217	3.71	
	Part-Time	718		1135	1.58	
	Total	1585		4352	2.74	
Medical	Full-Time	560		1565	2.79	
	Part-Time	29		149	5.14	
	Total	589		1714	2.91	
Total	Full-Time	8436		30231	3.58	
	Part-Time	5351		13719	2.56	
	Total	13787		43590	3.20	

TABLE A-4 (Continued)

[a]Figures in parentheses are recalculated to allow for 327 students who were excluded from this category in 1962-63.

[b]1969-70 Arts and Science includes 211 full-time and 40 part-time students reported in Arts and Science.

Source: Table A-3.

Part-time enrolment made up 33.2% of all graduate enrolment during the years 1962-63 to 1969-70. This proportion declined slightly but not steadily during the period. Absolute declines in part-time enrolment have not been large enough to lead to declines in total enrolment.

Among the disciplines, there appears to be some variation between faculties in the percentage of total graduate enrolment made up by part-time enrolment. This proportion changed between 1962-63 and 1969-70. While part-time enrolment has declined from 34.5% to 30.3% of graduate enrolment in arts, the corresponding decline in science has been from 17.0% to 10.9%.[11] Whereas this ratio has remained relatively constant for agriculture (13.2% to 13.9%); in commerce it has fallen from approximately 70% to about 45%; in education the fall in from 71.2% to 66.9%; and in engineering the part-time enrolment has fallen from 45.2% to 26.0%. These changes may indicate that some fundamental changes in the nature of graduate education in the professional schools have occurred in the past decade, especially in commerce and engineering, and these changes have resulted in greater incentives for students to complete their graduate work by full-time study.[12]

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[11] It should be noted that part-time enrolment has not grown as fast as full-time enrolment in either arts or science with the fall off being more pronounced for science. For agriculture however, part-time enrolment grew faster than full-time enrolment.

[12] Among the possibilities are financial support and admissions policies. The low part-time rates for graduate students in science, agriculture, and medicine relative to other faculties may be due to National Research Council support in these fields.

Examination of the changes in total graduate enrolment in the major faculties between 1962-63 and 1969-70 shows that the seven faculties can be grouped into three growth rates. Graduate enrolment in arts quadrupled in the period, while in science, education, medicine, and engineering it almost tripled. In agriculture and commerce graduate enrolment almost doubled.

The data discussed here have been drawn from the publications of the Dominion Bureau of Statistics (now Statistics Canada). For shorter time periods the data published by the Canadian Association of Graduate Schools are available.[13] These data cover a narrower range of institutions and apply a more restrictive definition of graduate students than do the Dominion Bureau of Statistics data.[14] In this study interest is focussed on the behaviour of these data over time and the data selected are those for which relatively long series are available.

Graduate Students: Graduations

Table A-5 presents data on earned doctorates and master's or licence degrees granted in Canada in the period 1919-20 to 1969-70. It shows that in

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[13] Canadian Association of Graduate Schools, Statistical Report 1968, 1969, 1970, 1971, (Winnipeg: Faculty of Graduate Studies, University of Manitoba, 1971). The most recent publishing agency has been provided. Earlier issues were published at the University of Calgary.

[14] Notes on these and other sources are provided in John B. Macdonald et al. The Role of the Federal Government in Support of Research in Canadian Universities, Special Study No. 7 prepared for the Science Council of Canada and The Canada Council, Cat. No. SS 21-1/7 (Ottawa: Queen's Printer, 1969), p. 199.

TABLE A-5

EARNED MASTER'S AND DOCTORAL DEGREES GRANTED IN CANADA 1919-20 TO 1969-70[a]

Year	Master's and Licence	Doctorate	Year	Master's and Licence	Doctorate
1919-20	213	24	1945-46	877	104
1920-21	218	24	1946-47	1084	116
1921-22	259	24	1947-48	1187	136
1922-23	315	31	1948-49	1619	194
1923-24	341	35	1949-50	1699	226
1924-25	323	33	1950-51	1632	202
1925-26	324	28	1951-52	1443	234
1926-27	362	40	1952-53	1418	262
1927-28	400	41	1953-54	1468	242
1928-29	363	51	1954-55	1361	271
1929-30	400	61	1955-56	1459	266
1930-31	468	46	1956-57	1500	292
1931-32	493	80	1957-58	1512	272
1932-33	529	87	1958-59	1710	284
1933-34	517	89	1959-60	2094	281
1934-35	481	77	1960-61	2447	305
1935-36	485	68	1961-62	2813	321
1936-37	600	78	1962-63	3152	421
1937-38	643	84	1963-64	3490	481
1938-39	632	80	1964-65	4096	569
1939-40	666	82	1965-66	5235	703
1940-41	673	75	1966-67	6249	787
1941-42	564	121	1967-68	7314	1006
1942-43	600	97	1968-69	6858	1108
1943-44	520	88	1969-70	8461	1375
1944-45	602	89			

[a]These data differ from those given elsewhere as follows:

Urquart and Buckley differ in the years 1951-52 and 1954-55 to 1957-58. Zsigmond and Wenaas differ for master's degrees in the years 1961-62 (2812), 1962-63 (3166), 1965-66 (5233) and 1966-67 (6253) and for doctorates in 1965-66 (697) and 1966-67 (788).

TABLE A-5 (Continued)

N. M. Meltz, Patterns of University Graduation by Field of Study in Ontario, Canada and the United States, 1950-51 to 1968-69, (Toronto: Institute for Policy Analysis, University of Toronto, 1971), differs for doctorates in 1964-65 (572), 1965-66 (697), 1966-67 (779), and 1967-68 (1005). The reasons for these differences are not readily apparent. None of the differences exceeds 1%.

Sources:

1919-20 to 1950-51: M. C. Urquart editor, and K. A. H. Buckley, assistant editor, Historical Statistics of Canada, (Toronto: Macmillan Company of Canada Ltd.) 1955) p. 603.

1951-52 and 1957-58 to 1959-60: Zsigmond and Wenaas, Enrolment in Educational Institutions, p. 160.

1952-53 to 1955-56: W. M. Illing and Z. E. Zsigmond, Enrolment in Schools and Universities, p. 145.

1956-57 and 1960-61 to 1969-70: Canada, Dominion Bureau of Statistics, Survey of Higher Education, Part II: Degrees, Staff, Summary, 1962-63 to 1969-70, Catalogue No. 81-211 (Ottawa: Queen's Printer, various years).

that period the number of masters degrees granted rose by a factor of about forty, while doctorates rose by about fifty-five times. The growth rates estimated for this data are 6.4% for masters and 7.0% for doctorates.

A new Statistics Canada publication has become available since these data were compiled.[15] The data presented there include most licences granted by French language universities in the bachelor's level, whereas except for 1969-70, the data above classify them with master's degrees. Also the new publication establishes a category called 'graduate diploma' for qualifications "obtained following a master's degree, a first professional degree, or a bachelor's degree in the same, or closely related field of study."[16] The data obviously differ greatly from those presented above. Table A-5 has not been modified because the new data exclude licences granted. The new Statistics Canada data are presented in Table A-8 below.

Both Meltz[17] and the new Statistics Canada eliminate licence data from the master's degrees results. An attempt was made to construct licence data for the period but was abandoned.

Although the general behaviour of these data is remarkably like that of total enrolment, the periods into which they have been classified differ, so that

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[15] Canada, Statistics Canada, Advance Release, Degrees and Diplomas Awarded by Canadian Universities and Colleges: 1960-61 to 1969-70, Cat. No. 81-548. (Ottawa: Statistics Canada, 1971).

[16] Ibid., Introduction.

[17] Full citation given in Table A-5.

some additional variations can be shown. (See Table A-6 for these analyses.) Between 1919-20 and 1932-33 master's graduations grew at 6.3% per annum while doctorates grew at 9.6% per annum. In the period of the great depression and the expanded manpower requirements of World War II, neither masters nor doctorate graduations grew at rates significantly different from zero, although there was a good deal of fluctuation in this period.[18] During 1944-45 to 1948-49, stimulated by grants to veterans to continue their university education, masters degrees granted grew at 22.8% per annum and doctorates at 18.3% per annum. Some readjustment seems to have occurred between 1948-49 and 1957-58 when masters degrees granted declined at 1.3% per annum (a rate which is significantly different from zero but does not reflect the fluctuations in the data in this period), while doctorates grew at 4.0%. Following 1957-58 masters degrees granted grew at 14.6% per annum, while doctorates grew at 14.5% per annum.

Doctorates appear to respond with a lag of zero to changes in masters degrees granted. It can be observed in Table A-6, that the coefficients of correlation with time do not differ greatly for master's degrees and doctorates within the periods chosen.

Table A-7 compares the cumulative totals of Canadian masters and doctoral graduations with the civilian labour force. Assuming a working lifetime

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[18] One particular instance is the jump of doctoral graduations from 75 to 121 in 1941-42 and back to 97 in 1942-43. A possible explanation is that doctoral students accelerated their work in order to obtain jobs in the war stimulated labour market.

TABLE A-6

REGRESSION ANALYSIS[a] FOR GROWTH RATES IN EARNED GRADUATE DEGREES GRANTED IN CANADA, SELECTED PERIODS, 1919-20 TO 1969-70

Period	Degree	Estimated Growth Rate	Constant	Coefficient of Correlation	Standard Error of Estimate	Number of Observations
1919-20 to 1969-70	Master	.064 (.002)	4.021 (.115)	.966	.255	51
	Doctorate	.070 (.002)	1.732 (.103)	.977	.230	51
1919-20 to 1932-33	Master	.063 (.005)	4.164 (.144)	.960	.081	14
	Doctorate	.096 (.010)	1.145 (.278)	.936	.156	14
1932-33 to 1944-45	Master	.013 (.008)	5.837 (.317)	.442	.109	13
	Doctorate	.014 (.010)	3.879 (.389)	.401	.134	13

TABLE A-6 (Continued)

Period	Degree	Estimated Growth Rate	Constant	Coefficient of Correlation	Standard Error of Estimate	Number of Observations
1944-45 to 1948-49	Master	.228 (.026)	-3.795[b] (1.231)	.981	.083	5
	Doctorate	.183 (.026)	-3.772[b] (1.223)	.971	.082	5
1948-49 to 1957-58	Master	-.0133 (.0066)	8.028 (.356)	-.577	.060	10
	Doctorate	.040 (.007)	3.367 (.377)	.895	.064	10
1957-58 to 1969-70	Master	.146 (.005)	-1.140 (.300)	.994	.063	13
	Doctorate	.145 (.008)	-3.008 (.543)	.982	.114	13

(Standard errors in parentheses)

Notes:

[a]The form of the regression is: $\ln G_t = a + bt$; where t is expressed as the last two digits of the last year in the academic year (so that 1933-34 is expressed 34); b is the estimated growth rate; and G_t is graduations in year t.

[b]Significantly different from zero at the 5% level on the two-tailed t-statistic test . All other coefficients are significantly different from zero at the 1% level on a two-tailed t-test.

Source: Table A-5.

TABLE A-7

ESTIMATED[a] NUMBERS OF ACTIVE HOLDERS OF HIGHER DEGREES GRANTED BY CANADIAN UNIVERSITIES AND PROPORTION OF CIVILIAN LABOUR FORCE, BY LEVEL OF DEGREE AND YEAR 1949-50 to 1970-71

Year	Masters & Licence	Doctorate	CLF[b] (000)	Proportion to Civilian Labour Force	
				Masters Licence %	Doctorate %
1949-50	16,758	2,183	5,092	0.33	0.043
51	18,244	2,385	4,892	0.37	0.049
52	19,658	2,563	5,236	0.38	0.049
53	20,842	2,773	5,344	0.39	0.052
54	21,945	3,004	5,461	0.40	0.055
55	23,072	3,211	5,557	0.42	0.058
56	24,110	3,449	5,666	0.43	0.061
57	25,245	3,687	5,843	0.43	0.063
58	26,383	3,939	6,094	0.43	0.065
59	27,495	4,170	6,213	0.44	0.067
1959-60	28,842	4,403	6,302	0.46	0.070
61	30,536	4,623	6,462	0.47	0.072
62	32,515	4,882	6,594	0.49	0.074
63	34,835	5,123	6,759	0.52	0.076
64	37,458	5,457	6,851	0.55	0.080
65	40,431	5,849	7,055	0.57	0.083
66	44,046	6,341	7,306	0.60	0.087
67	48,796	6,976	7,533	0.65	0.093
68	54,445	7,685	7,859	0.69	0.098
69	61,116	8,607	8,158	0.75	0.106
1969-70	67,342	9,635	8,403	0.80	0.115
71	75,137	10,928	8,677	0.87	0.126

Note: [a]These data are simple 30 year cumulative totals of graduations from Canadian institutions. The effects of the flow on of master's to doctoral qualifications, immigration, emigration, participation, mortality, morbidity and other factors affecting the numbers of higher degree holders in the Canadian civilian labour force have been ignored.

[b]Cumulative graduations include those up to and including the academic year prior to the year tabulated. Hence for 1949-50 the last years graduations included are for 1948-49. This cumulative total was divided by the civilian labour force for 1949 in order to derive the percentage data.

Source: Table A-5 and Statistics Canada.

of 30 years and 100% participation, Table A-5 enables us to estimate the number of holders of Canadian higher degrees remaining active from 1949-50 to 1970-71. These estimates were compared with civilian labour force data. In order to interpret the results in terms of percentage of civilian labour forces it is necessary to assume 100% participation for 30 years and zero participation thereafter. Even then the percentages may not be added because double counting would result since many doctorates obtain master's degrees before taking their doctorates. Note that such factors as immigration, emigration, participation, mortality and morbidity have been ignored.

The results of such estimates suggest that 30-year cumulations of both masters' degrees and doctorates' granted in Canada have almost tripled as percentages of the civilian labour force since 1949-50. For master's and licence degrees this proportion has increased from 0.33% in 1949-50 to 0.87% in 1970-71 while the change was from 0.043% to 0.126% for doctorate's.

Table A-8 presents some detail regarding the faculty composition of graduations in Canada in the years 1960-61 to 1969-70. These data are revisions of the data presented in Table A-5. They omit licence degrees and graduate diplomas from master's degree data, while including the Master of Social Work degree from all institutions.[19] A breakdown of the data on which Table A-5 is based was prepared, but has not been included because Statistics Canada now

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[19] See Statistics Canada, Advance Release: Degrees and Diplomas Awarded by Canadian Universities and Colleges, 1960-61 to 1969-70. (Ottawa: Statistics Canada, 1971).

TABLE A-8

MASTER'S DEGREES AND EARNED DOCTORATES
AWARDED BY CANADIAN UNIVERSITIES
BY FACULTY, 1960-61 to 1969-70

Year	FACULTY[c]																TOTAL	
	ARTS		SCIENCE PHYS & BIO		AGRICULTURE		BUSINESS		EDUCATION		ENGINEERING		MEDICAL & VETERINARY		SOCIAL WORK			
	M	D	M	D	M	D	M	D	M	D	M	D	M	D	M	D	M	D
1960-61	770	98	405	152	36	6	316	-	227	7	246	19	67	24	151	-	2222[a]	306
1961-62	820	77	415	165	61	16	339	-	259	17	286	20	78	26	175	-	2433	321
1962-63	929	96	486	242	46	14	391	-	338	12	304	26	92	31	170	-	2756	421
1963-64	1083	108	539	268	69	15	341	-	379	13	368	46	105	31	256	-	3140	481
1964-65	1217	133	600	314	68	11	460	-	387	24	446	43	124	44	282	-	3584	569
1965-66	1513	158	767	375	115	9	611	-	499	25	521	83	144	45	309	-	4479	697[b]
1966-67	1920	173	888	402	101	11	723	-	530	39	565	105	181	50	348	-	5256	780
1967-68	2210	230	916	527	105	13	570	-	594	73	747	108	211	55	389	-	5742	1006
1968-69	2666	276	1008	521	102	19	741	-	902	60	943	174	195	58	487	-	7044	1108
1969-70	3085	323	1196	614	162	67	971	-	1245	78	986	188	308	105	508	-	8461	1375
Ratio 1969-70 / 1962-63	3.3	3.4	2.5	2.5	3.5	4.8	2.5	-	3.7	6.5	3.2	7.2	3.3	3.4	3.0	-	3.1	3.3

TABLE A-8 (continued)

[a] Includes 4 master's degrees in unspecified fields.

[b] Reported total doctorate was 2 more than the sum of the fields for this year.

[c] Source data were grouped as follows: Arts includes, Fine and Applied Arts--Music, Humanities and Related, and Social Sciences and Related, less Commerce and Business Administration, and Social Work; Science includes Biological Sciences, and Mathematics and Physical Sciences; Medical and Veterinary includes Health Professions, and veterinary Medicine and Science; Agriculture is Agricultural Science. The remaining categories are straight forward.

Source:

Statistics Canada, Advance Release: Degrees and diplomas awarded by Canadian universities and colleges 1960-61 to 1969-70. (Ottawa: Statistics Canada, October 1971)

proposes that the revised data should replace the previous material.[20]

In order to retain some similarity with the treatment of enrolment data presented above, the changes over the period 1962-63 to 1969-70 are tabulated. Graduations in business at the master's level, and in science, at both levels, rose by two and one half times during this period, the slowest growth rates of any of the divisions studied. Graduations in arts and medical and veterinary, at both levels, more than tripled as did all graduations, and master's graduations in agriculture, engineering and social work. Fastest growing master's graduations were in education with an increase of 3.7 times. The fastest growth in doctorates occurred in engineering, where the multiple was 7.2, followed by education, which multiplied its doctorates by 6.5. In agriculture, doctorates grew considerably faster than master's degrees, as was the case for engineering and education.

When reviewing the performance of enrolment for this period in comparison with that of graduations, there appear some variations which may be worthy of further study. The comparability of graduations data and enrolment data is subject to serious qualification however.[21] While arts had the fastest

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[20]The breakdown of the previous data is a most laborious process since it involves aggregating some hundreds of subject categories.

[21]Enrolment data have been collected in faculty groupings, which are not exhaustive, and whose contents were determined by each individual university. Graduations data have been reported by detailed subject by Statistics Canada and compiled into faculties by Statistics Canada or the author. These groupings are exhaustive, i.e., no graduations are left out, some enrolments are.

growth of enrolment, its graduations growth was about average. Science had about average growth of enrolment and one of the lowest increases in graduations. In medicine, an average growth enrolment led to an average growth in graduations; while average growth in enrolment in education and engineering led to slightly higher than average growth in graduations, both warped towards doctorates. Slow growth of enrolment led to higher than average growth in graduations in agriculture and slower than average in business.

University demand for new teaching staff consists of two components, namely, those required to replace losses from the system and those required because of growth or change of structure. Under conditions of stable enrolment and structure, losses from the system depend upon the current size of academic staff and slowly changing components such as the age structure of staff. By comparing the current flow of doctoral graduations with the current stock of academic staff one obtains a measure of the capacity of the graduate education system to meet its own steady state demands. Note that this ignores non-university demands for doctorates.

In the 1920's, earned doctorates granted in Canadian universities amounted to about one percent of the unadjusted teaching staff at Canadian universities. Many Canadian students undertook their graduate study abroad and Canadian universities hired abroad. By about 1929 doctoral graduations reached two percent of staff and remained there through the depression and up to the second world war. There was considerable variability during this period with proportions as low as 1.3% in 1930-31 and as high as 3.2% in 1941-42. In the

early 1950's Canadian universities were granting earned doctorates in amounts approaching four percent of their teaching staffs. This proportion declined towards the end of the decade and then rose to about 5% by the end of the 1960's. Adjustment of teaching staff data to allow for definition changes does not reverse this trend. See Table A-9.

Thus the surpluses of higher degree holders reported since 1920 in Canada have occurred as graduate output grew relative to its steady state market in Canadian universities. These figures hide the situation in individual disciplines where annual doctoral production has been greater in the disciplines supported by the National Research Council than in the Humanities and Social Sciences. While about 56% of teaching staff at Canadian universities in 1967-68 were in the Humanities and the Social Sciences, only about 30% of the doctoral degrees granted were in those disciplines.[22] The effects of this imbalance appear in von Zur Muehlen's estimates of supply and demand for Ph.D.'s for teaching in Canadian universities. He makes allowance for occupational choice, foreign students returning to their home countries, and Canadians staying abroad, and returning to Canada. The surpluses he obtains are greatest in the physical sciences and smallest in the humanities. He also points out that Canadian practice has been to absorb in the universities 90% of doctorate's in the humanities and social sciences and 70 to 80% of doctorate's in the physical and biological sciences.

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[22] See Max von Zur Muehlen "The Ph.D. Dilemma in Canada: A Case Study" in Canadian Higher Education in the Seventies, Sylvia Ostry, editor. Sponsored by the Economic Council of Canada. (Ottawa: Information Canada, 1972), pp. 77-131, especially pp. 110, 111, 122, and 123.

TABLE A-9
EARNED DOCTORATES GRANTED AS A PERCENTAGE
OF UNIVERSITY TEACHING STAFF,
CANADA, SELECTED YEARS,
1919-20 TO 1969-70

Year	Percent of teaching staff data	Percent of corrected teaching staff data
1919-20	0.8	1.8
1929-30	1.7	3.2
1939-40	2.4	3.0
1949-50	3.8	4.9
1959-60	3.1	3.5
1969-70	5.8	5.8

Notes: See Tables A-5 and A-13.

Sources: Tables A-5 and A-13.

Von Zur Muehlen obtains replacement rates in the 1960's of 1.5 to 2.0% for university teachers in Canada,[23] compared with rates of production exceeding 5 percent observed above. In the event that Canadian universities do not grow or change in structure during the next decade, the relative youth of their present staffs indicates that replacement demand will not rise much above 2 percent. Thus even before applicants from the world's great universities are considered, 60 percent of Canada's crop of Ph.D.'s could not be absorbed in her universities. As noted above over 70% of Canada's Ph.D.'s have been accustomed to finding university positions.

Thus whereas surpluses have been reported when Canada's graduate education system could not be said to be self-sufficient, now, at least for low rates of growth, Canada is close to self-sufficiency in university teachers.

It has been suggested ". . . that only a limited portion of the college-age population (18 - 22) has the motivation and ability to complete a scientific or engineering course."[24] This portion would be stable over time. A similar position might be taken with regard to the Ph.D. Should graduations have reached such a saturation level they would show a reduction in the rate of growth of the proportion of the appropriate age group receiving the degree.

The presence of foreign students makes any conclusive test of the

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[23] Ibid., p. 103.

[24] Wallace R. Brode , "Manpower in Science and Engineering, Based on a Saturation Model," Science, 173 (16 July 1971), p. 206.

saturation hypothesis impossible without disaggregated data.

In 1920-21 earned Ph.D.'s granted in Canada amounted to 3.5 thousandths of one percent of the age group 25 - 29. In 1931-32 the proportion was 10.2 thousandths of one percent, and it fell to 9.0 thousandths of one percent in 1943-44. In 1951-52 the number of doctorates granted was 20.2 thousandths of one percent of the group 25 - 29 years of age. This proportion reached 26.6, 63.4 and 96.1 thousandths of one percent in 1961-62, 1966-67 and 1969-70 respectively. The source of Canada's Ph.D. students does not seem to be drying up.

Doctorate's granted in the physical and biological sciences in Canadian universities in the years 1961-62, 1966-67 and 1969-70 amounted to 13.7, 32.4 and 43.0 thousandths of one percent of those 25 - 29 years of age, respectively. There would have to be enormous increases in the proportion of foreign students receiving Canadian Ph.D.'s for these proportions to be stable when computed for Canadian born only.

Graduate Students: Income Expectations

Table A-10 shows median salaries of teachers at a selected group of Canadian universities for all ranks, Assistant Professors, and Lecturers and Instructors. These data are presented here because, as is discussed elsewhere, they relate to the enrolment and graduations data if graduate students are seen as expressing career choices in favour of academic life or of occupations which yield similar rates of pay.

Earlier data are scattered, but are available, and sources for them are

TABLE A-10
MEDIAN SALARIES OF TEACHERS AT 17 OR 19[a] UNIVERSITIES, BY RANK
CANADA, 1937-38 to 1971-72

Year	Rank		
	All Ranks	Assistant Professors	Lect. & Instruct.[b]
1937-38	$3,211	$ 2,761	$2,007
39	3,157	2,766	1,919
40	3,161	2,744	1,888
1940-41	3,217	2,787	2,049
42	3,175	2,783	1,967
43	3,253	2,836	2,070
44	3,351	2,858	2,021
45	3,355	2,849	2,029
46	3,459	2,993	2,169
47	3,482	3,028	2,214
48	3,662	3,334	2,393
49	3,837	3,507	2,562
50	3,858	3,593	2,673
1950-51	4,203	3,833	2,854
52	4,797	4,379	3,341
53	4,860	4,414	3,339
54	5,249	4,674	3,678
55	5,423	4,824	3,802
56	n.a.	n.a.	n.a.
57	5,892	5,180	4,074
58	6,713	5,835	4,558
59	7,445	6,664	5,143
60	7,979	7,117	5,573
1960-61	8,404	7,420	5,812
62	8,646	7,687	6,039
63	8,894	7,778	6,226
64	9,103	8,002	6,421
65	9,668	8,390	6,747
66	10,250	8,951	7,157
67	11,175	9,629	7,604
68	12,063	10,513	8,229
69	12,847	11,078	8,681
70	13,839	11,950	9,407
1970-71	14,887	12,739	10,000
72	15,865	13,403	10,454

TABLE A-10: continued

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[a]From 1966-67, data for University of Calgary and Ontario Institute for Studies in Education were included with the following 17 institutions: British Columbia, Alberta, Saskatchewan, Manitoba, Western Ontario, McMaster, Toronto, Victoria, Trinity, Queen's, McGill, Bishops, New Brunswick, Mount Allison, St. Francis Xavier, Acadia, Dalhousie.

[b]Attempts were made by the Dominion Bureau of Statistics to exclude part-time teachers and religious paid on a scale less than that for lay staff. The category lecturers and instructors may still contain some of these individuals.

Source: Canada, Dominion Bureau of Statistics, University Teachers' Salaries, 1957-1960, Cat. No. 81-203 (Ottawa: Queen's Printer and Controller of Stationery, 1960), pp. 12-13, Salaries and Qualifications of Teachers in Universities and Colleges, 1969-70, Cat. No. 81-203 (Ottawa: Queen's Printer, 1970), pp. 32-33, and Statistics Canada, Salaries of Teachers in Degree-Granting Institutions, Part I, General Characteristics, 1971-72, Cat. No. 81-241 Annual (Ottawa: Information Canada, 1972), pp. 34-35.

given by the Dominion Bureau of Statistics.[25] It should be noted that many teachers earn income in excess of their basic annual salary rates, and this income is excluded from Table A-10 although it is most relevant to the occupational choice framework mentioned in the previous paragraph.

The commentary on these data, provided in the source, is adequate for the present. The effects of the depression of the 1930's were still apparent in the Consumer Price Index and in salaries until about 1945. The World War of 1939-45 caused some staff to enter the armed forces. Immediately following the war, returned soldiers received government grants to continue their education and the resulting influx of students resulted in staffing difficulties during these years.[26]

Median salaries have behaved similarly to graduate enrolment and graduations, but casual observations of these data plotted against time suggests

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[25] University Teachers' Salaries, 1937-1960, Cat. No. 81-203 (Ottawa: Queen's Printer and Controller of Stationery, 1960), p. 32.

[26] In this respect the following quotations from Canada, Dominion Bureau of Statistics, The Canada Year Book, 1947, (Ottawa: King's Printer and Controller of Stationery, 1947), p. 290, reveal one of the means used by the universities to resolve these difficulties.

"As the registration increased during 1945-46, the problem of staff became acute. One potential source of teaching personnel was the student veteran group enrolled for post-graduate training. Through co-operation with the Department of Veteran's Affairs, a system of part-time teaching was developed for such students to the mutual advantage of university and veteran."

The same source reveals that some servicemen were released overseas to pursue graduate studies there. In addition three continuous sessions were run during the year and admissions were staggered with special courses starting in January and May. See Ibid., p. 289.

that increases in salaries have lagged increases in enrolment or graduations. These data can be used in assessing shortages.[27]

Data on salaries for all ranks must be used with caution because variations in them can occur due to changes in the rank composition, not only due to changes in the salaries of university teachers. Data on assistant professors and on lecturers and instructors are less subject to this qualification.

Further material on university staff salaries by faculty, field, subject and years since award of first and highest degree for 65 Canadian institutions and for several years are available from the same source.[28] These additional data should be particularly useful for the study of lifetime income profiles over time.

Data on salaries which are not restricted to university employment have been generated by surveys of the Scientific and Technical Personnel Register and by the Survey of Professional and Technical Manpower-1967.[29]

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[27] See Chapter 2. The lag behind enrolment suggests that the shortage measure obtained may also be lagged.

[28] Canada, Dominion Bureau of Statistics, Salaries and Qualifications of Teachers in Universities and Colleges: 1969-70, Cat. No. 81-203 (Ottawa: Queen's Printer, 1970).

[29] See Canada, Department of Labour, Economics and Research Branch, Engineering and Scientific Manpower Resources in Canada: Their Earnings, Employment and Education, 1957, 1959, and 1960-61, Professional Manpower Bulletin No's. 7, 9, and 10, Cat. No's. L2-2007, L2-2009, and L2-2010 (Ottawa: Queen's Printer and Controller of Stationery, 1959, 1960, and 1961). Also see _____, Employment and Earnings in the Scientific and Technical Professions: 1958-1961 and 1959-1962, Professional Manpower Report No's. 12 and 14, Cat. No's. L2-2012 and L2-2014, (Ottawa: Queen's Printer and Controller of Stationery, 1962 and 1963). More recent information is available in Canada, Department of Manpower and Immigration, Program Development Service, Manpower Information and Analysis Branch, Survey of Professional, Scientific,

Table A-11 presents a collection of starting salaries data, by faculty and level of degree, for Canada from 1960 to 1971. They are composed from two sources and constitute the most extensive consistently collected set of published starting salaries data available for Canada, for graduate degree holders, that has come to the attention of the author. They are also useful for the study of shortages and surpluses.[30]

These data may not be consistently accurate as a number of anomalies occur in them and the construction of the table has been achieved by resorting to a variety of resources. It has been achieved by consistently applying the rules discussed below.

The major source of these data is a survey of employers conducted annually by the Pay Research Bureau of the Public Service Staff Relations Board in cooperation with the Department of Manpower and Immigration.[31] This survey

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Technical Manpower - 1967: Selected Tabulations (Ottawa: Department of Manpower and Immigration, n.d.) and in A. G. Atkinson, K. J. Barnes, and Ellen Richardson, Canada's Highly Qualified Manpower Resources, Cat. No. MP32-6/1-1960 (Canada: Department of Manpower and Immigration, 1970; Ottawa: Information Canada, 1970).

[30] See Chapter 2.

[31] This survey has been published as follows: Canada, Department of Manpower and Immigration, Manpower Information and Analysis Branch, Professional and Technical Occupations Section, Starting Salaries for University Graduates: 1959 to 1966, Reprint, Series 'A', Volume 1 (Ottawa: Department of Manpower and Immigration, 1967) part b; _____, Requirements and Starting Salaries: University Graduates: 1966 to 1968, Reprint, Series 'A', Volume 2 (Ottawa: Department of Manpower and Immigration, 1969); Canada, Department of Manpower and Immigration, Program Development Service, Manpower Information and Analysis Branch, Professional and Technical Occupations Section, Requirements and Average Starting Salaries: University Graduates: 1969 (Ottawa: Department of Manpower and Immigration,

TABLE A-11
MEAN MONTHLY STARTING RATES ACTUALLY PAID TO
MASTER'S & DOCTORAL GRADUATES, BY FACULTY, CANADA, 1960 TO 1971

Year	FACULTY											
	Arts		Science		Agriculture		Business[d]	Education		Engineering		Social Work
	M	D	M	D	M	D	M	M	D	M	D	M
1960	400[b]		445[b]	606[b]			426[b]			463[b]		383
1961[a]			453	582			407			478	630	
1962[a]	455		472	612			450	550		479	615	433
1963[a]	462		484	678			451			487	700	
1964[a]	457		502	724			450			503	713	430
1965	505	668	546	723	496[a]	675[a]	551	512	852	562	735	458
1966	562	734	583	753	566[a]		622	559		610	781	516
1967	593	784	652	816	618	807	695	600	890[a]	662	823	566
1968	661	806	686	869	671	820[a]	755	711	940[a]	721	913	629
1969	680	932	711	915	788		763	654		733	948	679
1970	729	921	734	947	720		771	699	990	766	990	734
1971	731	966	738	941		979	834	849	1,066	775	978	818
1972	790	978	758	952			871	902	1,155	809	1,030	823
1973[c]	767	1,009	749	864			868	901	1,107	752	972	886

[a]These data were contained in the alternative sources entitled Career Outlook and not in the major source. See text for a full citation of this source and a discussion of the rationale for including the data here.

TABLE A-11: continued

[b]These data are weighted means computed from published salaries and numbers hired. "Arts" includes Psychology.

[c]Estimate only.

[d]For Business the salaries for students entering CA articles are occasionally published also. These data include all masters' degrees in business regardless of their employment.

Sources: See text. In general these data are obtained from actual salaries paid rather than from forecasts based on requirement surveys. The most recent sources used are: Canada, Department of Manpower and Immigration, Manpower Information and Analysis, Program Development, Requirements and Salaries, University Graduates, 1972, Cat. No. MP45-372 (Ottawa: Information Canada, 1972), _____, Supply and Demand, New University Graduates, 1971, Cat. No. MP32-2/3-1971 (Ottawa: Information Canada, 1971), pp. 23-27 and Canada, Department of Manpower and Immigration, Strategic Planning and Research, Supply, Demand and Salaries: New Graduates of Universities and Colleges, 1973, Cat. No. MP32-2/15-1973 (Ottawa: Information Canada, 1973).

yields data on anticipated hirings and anticipated starting salaries for the hiring season starting in the early spring of the year. Actual hirings and starting salaries are obtained for the previous hiring season and these data have been used to construct Table A-11, as far as possible.

In constructing the table some care has been devoted to separating actual observations from anticipations. Unfortunately, the distinction is not always clear from the published material, especially since 1968. The general assumption that, in each publication, data pertaining to the year previous to the title year are actual data has been adopted. For the year 1969, for some faculties, this led to results which could not be reconciled with similar data elsewhere.[32] The year 1969 produced apparently erratic results for some faculties and levels, whichever source is used. No variation from the general rule stated above was made.

A subsidiary source of data is collected by student placement officers of

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1969); _____, Requirements and Average Starting Salaries: University Graduates: 1970, MP32-2/4-1970 (Ottawa: Information Canada, 1971); _____, Preliminary Report: Requirements and Average Starting Salaries: University Graduates: 1971, MP32-2/4-1971 (Ottawa: Information Canada, 1971). This source is here-in-after referred to as the 'Requirements Survey'.

[32] These similar data, which combine data from student placement offices with those from the employers' survey discussed above have also been published. That publication is Canada, Department of Manpower and Immigration, Program Development Service, Manpower Information and Analysis Branch, Professional and Technical Occupations Section, Requirements and Average Starting Salaries: University Graduates: 1969, (Ottawa: Department of Manpower and Immigration, 1969).

the Department of Manpower and Immigration. These data have been combined with that collected in the Pay Research Bureau Survey discussed above and published under the title Career Outlook.[33] This source has not been used in its entirety, because there was a change in definition, from estimated to mean actual starting salaries in 1968.

These data differ from the 'Requirements Survey' data in most cases, the difference being due to the inclusion of additional information from student placement offices.[34]

In order to test the hypothesis of no significant difference between these two data sources the common data were regressed against each other, with the 'Requirements Survey' data as dependent variable.[35] A two-tailed test using the

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[33]These data, hereinafter referred to as the 'Career Outlook' data have been published as follows: Canada, Department of Manpower and Immigration, Manpower Information and Analysis Branch, Professional and Technical Occupations Section, Starting Salaries for University Graduates: 1959 to 1966, Reprint, Series 'A', Volume 1 (Ottawa: Department of Manpower and Immigration, 1967), part a; Canada, Department of Manpower and Immigration, Program Development Service, Manpower Information and Analysis Branch, Career Outlook: University Graduates: 1967-68, MP2-28/1967 (Ottawa: Queen's Printer and Controller of Stationery, 1967); _____, Career Outlook: University Graduates: 1968-69, MP32-2/2-1969 (Ottawa: Department of Manpower and Immigration, n.d.); Canada, Department of Manpower and Immigration, University: Career Outlook: 69-70, MP32-2/2-1970 (Ottawa: Department of Manpower and Immigration, n.d.); Canada, Department of Manpower and Immigration, Program Development Service, Manpower Information and Analysis Branch, University: Career Outlook: 70-71, MP32-2/2-1971 (Ottawa: Information Canada, 1970).

[34]Letter from C. Courtemanche, Head, Graduate Requirements Section, Department of Manpower and Immigration, Ottawa: January 31, 1972.

[35]For Arts and Science, the average of reported salaries was used for this test, because no 'All Graduates' category for these faculties is provided in earlier data.

t statistic was conducted.[36]

For the case of bachelor's and higher degree data taken together, this test indicated that using 'Career Outlook' data instead of the appropriate 'Requirement Survey' data results in an overestimate of almost $15.00 irrespective of the size of starting salary concerned. It was considered that an error in the order of 3% was tolerable.

After the above test was made it was observed that a similar test should be run for the graduate degrees data alone. In this case the practice of calculating means in the 'Career Outlook' data as unweighted averages of the subjects reported in the faculties of engineering, arts and science, was abandoned for 1969 and 1970 since 'All Graduates' averages were available for those years.[37]

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[36] For the linear regression including bachelor's degree data, 144 common observations were available, the correlation coefficient was .985, the intercept term was 14.470 with a t statistic of 1.692 (significant at the 10% level), and the slope coefficient was .988 with a t statistic of 67.320. For the slope coefficient we wish to test whether it is significantly different from unity, not zero as for the intercept. The appropriate t statistic is t = (.988-1) divided by .0147 = -.800, where the standard error of estimate of the slope coefficient was .0147. This estimate is significantly different from unity only at the 50% level.

[37] Twelve observations are affected for the graduate calculation. Simple linear regression on 60 common observations gave a coefficient of correlation of .9558, an intercept term of $41.09 (standard error $27.30) and a slope coefficient of .9619 (standard error .0388). The t statistics for the intercept term is 1.504 which is significant at the 20% level. Testing the slope coefficient for difference from unity requires subtracting one from the estimate. The t statistic is .9808 which is significant at the 40% level.

In this case using 'Career Outlook' data as a substitute for 'Requirement Survey' data results in an over estimate of $41.00 irrespective of the size of the starting salary concerned. However, the overestimate is only significant at a 20 percent level of confidence as compared with the 10 percent level associated with the previous case. In this case the error averages 7 percent and is a maximum of 10 percent of the values actually substituted.

These results suggest that the data constructed are useful, within limits, for the study of the employment of new university graduates in Canada. The limitations of the collection procedures appear to be at least as potent a source of errors as is the splicing procedure described above. Rates of growth of starting salaries may be slightly underestimated because of the use of substitute data in earlier years, which are slight overestimates of the true values.

Casual observation of Table A-11 reveals that, in the period 1962 to 1970, all starting salaries rose between 1.6 and 1.7 times, except for those earned by master's degrees in education, which rose by only 1.3 times. No data were available for doctorates in arts or education or for any degrees in agriculture.

Graduate Students: Stipends

For a discussion of the earnings and expenditures of graduate students prior to graduation, and of the available data, see Appendix B.

Graduate Students: Post-Graduate Unemployment

The Ontario Council on Graduate Studies has published data on the employment of Ph.D.'s graduated from Canadian universities in 1970-71 and 1971-72, and on the employment of Ph.D.'s graduated from Ontario universities during

the periods 1964-69, 1969-70, 1970-71, and 1971-72.[38] In these surveys, students were classified as unemployed if, at the time of the survey they were unable to report definite employment. In the case of the first period, 1964-69, the unemployed had remained so until the summer and fall of 1969. These data were collected by questionnaires sent to the ex-student's supervisor or department. Although alternative procedures are not obvious, there does seem to be a possibility of respondent bias in this particular one.

These data give a total of 6 Ph.D.'s, out of 1517 for whom data were obtained from Ontario universities, who reported themselves to be unemployed immediately post-graduation for the period 1964-69. It is reasonable to assume that these individuals simply decided not to participate in the labour force anywhere. Furthermore, 5 of the 6 were outside Canada. However, for the years 1969-70, 1970-71 and 1971-72 these numbers were 15 of 606, 39 of 698 and 36 of 793 respectively. As percentages these figures are 2%, 6% and 5% respectively, of those Ontario Ph.D.'s whose fate was discovered from the survey. For Ph.D.'s graduated in 1970-71 in Canada (excluding Laval) 72 or 5% of a total of 1314

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[38] See Ontario Council on Graduate Studies, "Survey of Employment of Ontario Ph.D. Graduates--1964-69," (Toronto: Committee of Presidents of Ontario Universities, December 1970) mimeo, and _____, Supplement #1, January 1971. These data and extensions are reprinted as Appendix 3 in Council of Ontario Universities, "Graduate Enrolments in Relation to Requirements for Academic Staff in Ontario Universities," Brief to the Ontario Committee on University Affairs, 71-14 (Toronto: Council of Ontario Universities, 1971) mimeographed. For 1971-72 see Canadian Association of Graduate Schools, Press Release "Employment of New Ph.D. Graduates: 1971-72", December 14, 1972.

reported themselves unemployed, 8 of whom were out of Canada. In 1971-72, 53 of 1446 or 4% of Ph.D.'s graduated in Canada reported as unemployed. This certainly suggests that unemployment rates among just graduated Ph.D.'s have become greater than zero.

The unemployment data differ by discipline with health sciences showing a zero unemployment rate, social sciences showing about 2% and the humanities, physical sciences, engineering, and life sciences showing between 6 and 8% of Canada's Ph.D.'s unemployed immediately after graduation. On the other hand the July 1970 unemployment rate among 14 - 24 year olds who had been full-time students in March was 13.8% and the rate among 14 - 24 year olds who had been full-time students in March but were not planning to return to school was 21.1%. The overall 14 - 24 year old unemployment rate was 10.9%.[39] These data are not strictly comparable, as was noted above, since the later figures are drawn from the Labour Force Survey and use Canadian Labour Force definitions. Nevertheless it would be difficult to support the argument that higher degree holders suffer from particularly high levels of unemployment immediately after graduation in Canada.

The Ontario Council on Graduate Studies data provide a great deal more information than that on unemployment. Employment is broken down into the categroies of university teaching, industry, research fellowship, private research

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[39] Canada, Statistics Canada, Facts About the Unemployed, 1960-71, Cat. No. 71-520 (Ottawa: Information Canada, 1971) Table 11, p. 28.

institute, government, unemployed, and other. Data are provided for humanities, social sciences (excluding education), physical sciences (including mathematics), engineering, life sciences, and health sciences separately. Further data for Ontario Ph.D.'s on their eventual employment as well as on their immediate post-graduation employment were collected. There are also tabulations of Ph.D.'s granted by citizenship, country of origin, country of first degree, change of citizenship after degree, citizenship on entry and discipline, university, and year of graduation. Many of these sources are unique although it might fairly be said of some of them that they stretch the capacity of the collection procedure.[40]

It would be particularly useful to have data on unemployment by level of education for the higher degree levels of education. The Labour Force Survey of Statistics Canada has collected these data periodically but only for levels of education up to completed high school.[41] These data show a decline in unemployment rates as education levels rise, but it is not clear how much of that decline is due to seasonal factors. We do not know whether this decline continues for higher levels of education.

In the case of India, Blaug, Layard and Woodhall found that

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[40] Newspaper accounts of the quarterly findings of the Technical Service Council, set up in 1927, may provide a valuable additional source of data on post-graduation unemployment.

[41] See Canada, Dominion Bureau of Statistics, Educational Attainment of the Canadian Population and Labour Force-1960-65, Dominion Bureau of Statistics Special Labour Force Study No. 1, Cat. No. 71-505 (Ottawa: Queen's Printer and Controller of Stationery, 1966), p. 13 and Table 8.

TABLE A-12

FULL-TIME UNDERGRADUATE[a] ENROLMENT IN THE REGULAR WINTER SESSION, CANADIAN UNIVERSITIES AND COLLEGES, 1919 - 20 TO 1972 - 73

Year	Enrolment	Year	Enrolment	Year	Enrolment
1919-20	21,869	1937-38	34,460	1955-56	69,310
21	22,791	39	35,164	57	75,046
22	24,114	1939-40	35,903	58	82,699
23	25,212	41	34,817	59	90,444
24	24,530	42	34,680	1959-60	96,690
25	24,805	43	35,692	61	107,346
26	24,852	44	35,132	62[b]	121,547
27	25,734	45	38,376	63[b]	132,952
28	26,932	46	61,861	64[c]	147,225
29	28,306	47	76,237	65	164,441
1929-30	30,209	48	79,346	66	188,692
31	31,576	49	75,807	67	212,953
32	32,862	1949-50	69,111	68	237,020
33	33,166	51	64,036	69[c]	243,973
34	32,596	52	59,849	1969-70[d]	268,219
35	33,051	53	60,046	71[d]	282,550
36	33,522	54	61,198	72[e]	306,030
1936-37	33,918	1954-55	65,032	1972-73[e]	326,160

[a]Undergraduate enrolment excludes all students studying ~~for~~ graduate degrees, diplomas and certificates. In general it includes all candidates for first professional degrees even when a Bachelor's degree is required for entry. See also notes b and c. Full-time is discussed in the introduction to this appendix.

[b]Prior to 1962-63 some graduate enrolment was included in undergraduate enrolment in social work and theology. Therefore the totals are not strictly comparable with those for earlier years. Data up to 1961-62 exclude Normal School Students and nurses studying for R.N. From 1962-63 the data are numbers of undergraduates in courses for which matriculation is pre-requisite, which exclude, in the main, students in high school courses, the first four years of the eight-year classical college bacalauréat ès arts course, and student nurses taking R.N. courses. As Normal Schools were incorporated into universities in a number of instances students in these institutions are included in undergraduate enrolment for later years.

[c]Beginning in 1963-64 most students enrolled in a licence degree programme were reported as graduate students, with the main exceptions being Law and Optometry. Beginning in 1968-69, the licence has been reported as an undergraduate degree.

[d]For 1969-70 the sum of undergraduates and students not preparing university awarded degrees is reported i.e. 263,013 + 5206. This is in accord with instructions given in Survey of Higher Education Part 1, 1969/70, p. 12.

For 1970-71 the sum of those enrolled for undergraduate degrees diplomas and certificates with those reported as not preparing university awarded degrees diplomas and certificates is presented.

[e]Data for these years are drawn from Advance Statistics of Education 1971-72, Table 8,p. 31. These data include students in non-university level programmes. They are forecasts.

TABLE A-12 (Continued)

Sources:

1919-20 to 1961-62: Canada, Dominion Bureau of Statistics, Survey of Higher Education, 1961-62, Cat. No. 81-211, (Ottawa: Queen's Printer and Controller of Stationery, 1964), Table 15.

1962-63 to 1969-70: Canada, Dominion Bureau of Statistics, Survey of Higher Education, Part I: Fall Enrolment in Universities and Colleges, 1965-66, 1968-69, 1969-70, Cat. No. 81-204, (Ottawa: Queen's Printer, 1966, 1969, 1970).

1970-71: Canada, Statistics Canada, Fall Enrolment in Universities and Colleges, 1970-71, Cat. No. 81-204 (Ottawa: Information Canada, 1972), Table 6A, pp. 30-31.

1971-72 to 1972-73: Canada, Statistics Canada, Advance Statistics of Education, 1971-72, Cat. No. 81-220, (Ottawa: Information Canada, 1971).

TABLE A-13

ESTIMATED[a] GROWTH RATES IN FULL-TIME UNDERGRADUATE ENROLMENT, SELECTED PERIODS, CANADA
1919-20 TO 1972-73

Period	Estimated Growth Rate	Constant	Coefficient of Correlation	Standard Error of Estimate	Number of Observations
1919-20 to 1972-73[b]	.049 (.002)	8.743 (.102)	.956	.238	54
1919-20 to 1932-33	.031 (.003)	9.369 (.074)	.955	.042	14
1932-33 to 1942-43	.009 (.002)	10.115 (.058)	.883	.016	11
1942-43 to 1972-73[b]	.068 (.004)	7.581 (.243)	.951	.205	31

(Standard errors in parentheses)

TABLE A-13 (Continued)

Notes:

[a]The natural logarithm of enrolment was regressed against the last two digits of the academic year. All coefficients are significantly different from zero at the 1% level on the two-tailed t-statistic test.

[b]For 1969-70 and 1970-71, 269,930 and 283,750 were used as enrolment data respectively. from Advance Statistics of Education, 1971-72.

Source: Table A-12.

TABLE A-14

TEACHING STAFF AT CANADIAN UNIVERSITIES[a]
1919 - 20 TO 1972 - 73

Year	Staff	Corrected
1919-20[b]	2998	1300
21	3322	1440
22	3142	1360
23[b]	3532	1530
24[c]	3452	1500
25	2260	1580
26	2570	1800
27	3379	2360
28[c]	3215	2250
29[d]	2862	2000
1929-30	3525	1920
31	3661	2000
32	3977	2170
33	4091	2230
34[d]	4128	2250
35[e]	4196	2290
36	3044	2360
1936-37	3191	2480
38	3359	2610
39	3412	2650
1939-40	3480	2704
41	3771	2930
42	3756	2920
43	3836	2980
44	4009	3120
45	4012	3120
46	5118	3980
47	5710	4440
48	6299	4890
49	5912	4590

TABLE A-14 (Continued)

Year	Staff	Corrected
1949-50	5968	4640
51	5683	4420
52	6207	4820
53	6453	5010
54[e]	6869	5340
1954-55[f]	6474	5610
56	6719	5820
57	7000	6070
58	7500	6500
59	8200	7100
1959-60[f]	9200	7970
61[g]	8780	-
62	9490	-
63	10600	-
64	12230	-
65	13340	-
66	15100	-
67	18200	-
68	20600	-
69	23500	-
1969-70[g]	23900	-
71[h]	24516	24820
72[h]	25984	26300
73[h]	27595	27930

[a]These data are drawn from a variety of sources and a variety of definitions have been used. Details have been noted below. Details of the correction are given in the text.

[b]For the years 1919-20 to 1923-24 the data are for all grades of academic staff full and part-time. They are drawn from the Canada Year Book for the particular year.

[c]From 1924-25 to 1928-29 the data report full-time academic staff in all grades. For 1924-25 staff in preparatory grades are omitted. They are drawn from the Annual Survey of Education in Canada.

TABLE A-14 (Continued)

[d]From 1929-30 to 1934-35 the data report full-time academic staff in Arts, Science, and Professional faculties. The source is the Annual Survey of Education in Canada.

[e]From 1935-36 to 1953-54 the data report full-time academic staff in Arts, Science, and Professional faculties. The sources are Higher Education in Canada or later, Survey of Higher Education. These data differ in previous years from the Annual Survey data.

[f]Between 1954-55 to 1959-60 two definitions are used. For 1954-55 and 1955-56 full-time academic staff including research staff and excluding pre-matriculation teachers were estimated by the Dominion Bureau of Statistics from survey returns and university calendars. These data were reported in the Canada Year Book, 1959. From 1956-57 to 1959-60 the data are estimated full-time academic staff obtained from the Canada Year Book, 1965.

[g]From 1960-61 to 1969-70 the data report estimates of full-time academic staff drawn from reports of 50-90% of the Canadian institutions and were obtained from the Canada Year Book 1970-71.

[h]The data for 1970-71 to 1972-73 are estimates from survey returns which include estimates for non-reporting institutions and are published in Advanced Statistics of Education. Data for 1971-72 and 1972-73 are forecasts. This source has not in the past agreed with the eventual Canada Year Book data.

Sources:

1919-20 to 1923-24: Canada, Dominion Bureau of Statistics, The Canada Year Book, 1920, 1921, 1922-23, 1924, 1925 (Ottawa: Printer to the King's Most Excellent Majesty, 1921, 1922, 1924, 1925, 1926).

1924-25 to 1934-35: Canada, Dominion Bureau of Statistics, Annual Survey of Education in Canada, 1925 to 1935 (Ottawa: Printer to the King's Most Excellent Majesty, 1926 to 1937).

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TABLE A-14 (Continued)

1935-36 to 1944-45, Canada, Dominion Bureau of Statistics, Higher Education in Canada, 1938-40 to 1944-46, Being Part II of the Biennial Survey of Education in Canada, 1938-40 to 1944-46. Cat. No. 81-402 (Ottawa: Printer to the King's Most Excellent Majesty, 1941 to 1949).

1945-46 to 1953-54: Canada, Dominion Bureau of Statistics, Survey of Higher Education, 1946-48 to 1952-54, Cat. No. 81-402 (Ottawa: Queen's Printer and Controller of Stationery, 1950 to 1957).

1954-55 to 1969-70: Canada, Dominion Bureau of Statistics, Canada Year Book, 1959, 1965, 1970-71 (Ottawa: Information Canada, 1959, 1965, 1971). See also _____, Survey of Higher Education 1954-61, Cat. No. 81-518, (Ottawa: Queen's Printer and Controller of Stationery, 1963).

1970-71 to 1972-73: Canada, Statistics Canada, Advance Statistics of Education, 1971-72 Cat. No. 81-220 (Ottawa: Information Canada, 1971).

unemployment rates rise until matriculation is reached (the equivalent of about half way through U.S. senior high school) and then decline for the step to graduate (completed U. S. junior college).[42] The U. S. literature has not been examined on this point.

Universities: Undergraduate Enrolment

Table A-12 presents full-time undergraduate enrolment at Canadian universities since 1919-20. The magnitude of the increase in enrolment, which followed the second world war, is illustrated by noting that in the 25-year period 1919-20 to 1944-45 enrolment increased by 1.75 times, whereas in the 25 years 1944-45 to 1969-70 enrolment increased by more than 6.25 times. Within both these periods there were years in which enrolment declined in absolute numbers. The rate of growth of full-time undergraduate enrolment after the second world war was approximately double its value between 1919-20 and 1932-33.

The results of growth rate regression analysis of these data on time are presented in Table A-13.

Universities: Teaching Staff

Data on teaching staff at Canadian universities are presented in Table A-14. As is pointed out in the notes to this table, there are variations in the definitions used in these data over time. An attempt has been made to adjust these

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[42] Blaug, Layard, Woodhall, The Causes of Graduate Unemployment in India, p. 75 and p. 1, note.

data for definition changes. Caution should be used in dealing with these data.

These data indicate that the rate of growth of academic staff has risen since the second world war. It is interesting to note that the number of academic staff increased very rapidly to cope with the immediate post-war bulge in enrolment, increasing from 4012 in 1944-45 to 5118 in 1945-46, or by about 28% to cope with an increase in undergraduate enrolment of about 61%. Between 1947-48 and 1951-52, full-time undergraduate enrolment declined from 79,346 to 59,849 (about 25%). In the shorter period, 1947-48 to 1950-51, teaching staff declined from 6299 to 5683 (about 10%), but had recovered to 6207 in 1951-52 leaving a decline of only about 2%. This particular instance suggests that teaching staff were less sensitive to declines in undergraduate enrolment than to the preceding increase. Whether this has been a general behavior pattern is not known.

More reliable data are available on the numbers of academic staff at 17 selected universities. These data are available from 1937-38 in the same source as that for academic salaries.[43]

Table A-14 also presents the results of a proportional adjustment of these data for the changes in definition mentioned above. The definition in effect from 1960-61 to 1969-70 was taken as a base. The proportional changes in the teaching staff series in the years immediately preceding and following the year in

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[43]Canada, Dominion Bureau of Statistics, University Teacher's Salaries, 1937-1960, Cat. No. 81-203 (Ottawa: Queen's Printer and Controller of Stationery, 1960) subsequently Salaries and Qualification of Teachers in Universities and Colleges, Cat. No. 81-203.

which a definition change occurred were measured. These changes were interpolated by taking the square root of their product and this value was used as an estimate of the proportional change of the series in the year concerned. Using this estimated proportional change, an estimate was obtained for the 'constant definition' value in the preceding year. Data back to the next definition change were then adjusted by the proportion this estimate was to the observed value. The resulting estimates may be summarized as vertical shifts of the data so as to produce interpolated transitions on a log-linear plot. See Figure 2-1 or A-1.

The scale of the adjustment emphasizes the weakness of available data sources. The adjusted data grew at an estimated rate of 5.4 percent per year over the period 1919-20 to 1972-73, according to growth rate regression analysis.

Universities: Capital

Estimates were made of the value at cost of university sites, buildings and equipment in Canada. Table A-15 presents these estimates.

The estimation was performed by constructing a series of annual increments to land, buildings, and equipment for the period 1920-21 to 1967-68. This series was constructed from a series giving the dollar value at cost of university plant (land, buildings, and equipment) from 1920-21 to 1954-55 and another series giving current dollar additions to plant from 1954-55 to 1967-68. For the period 1920-21 to 1954-55 the derived series of increments was deflated to 1961 dollars and then cumulated with the 1920-21 value of plant, to give an estimate of the value at cost of university plant in Canada in 1961

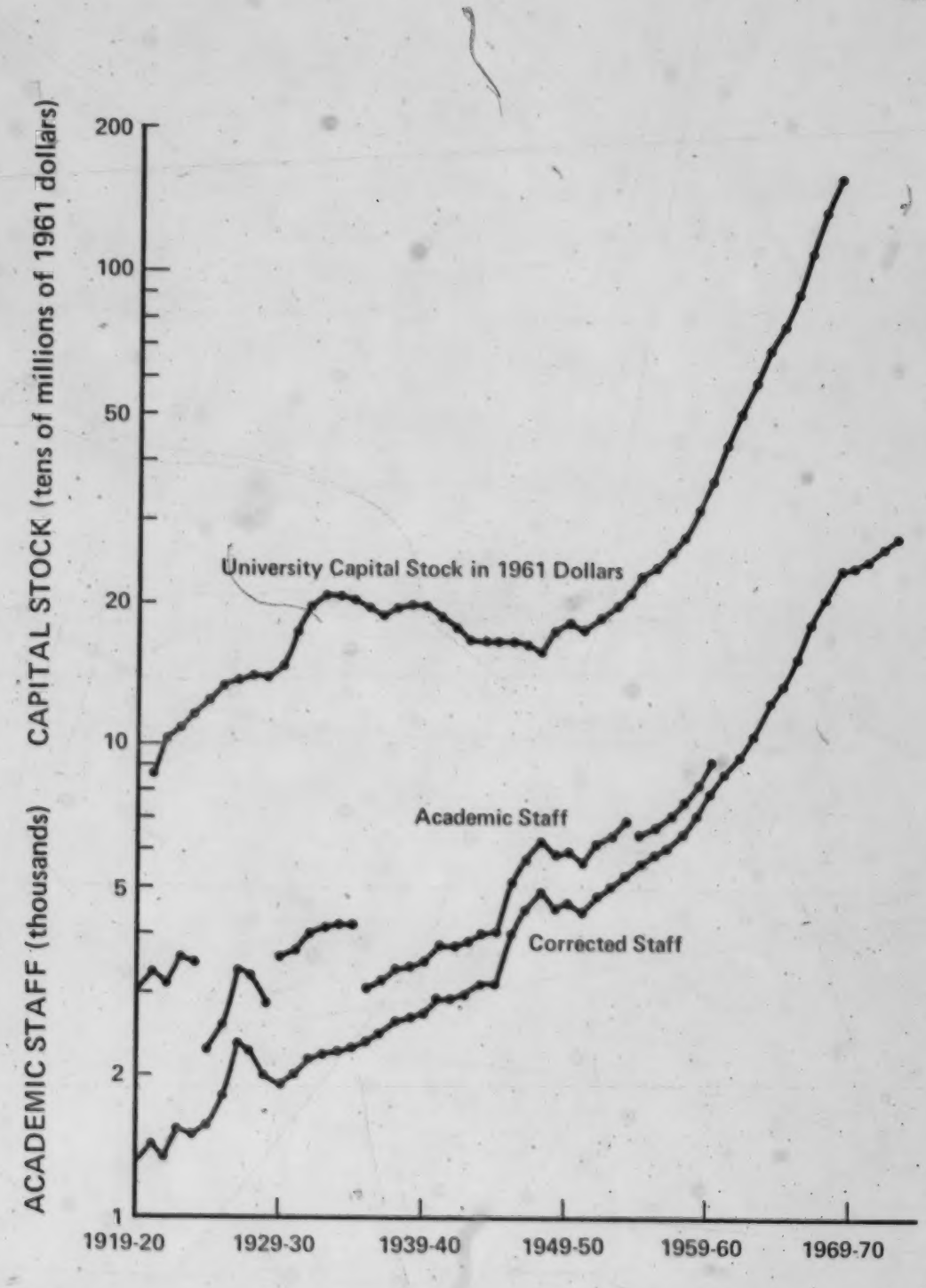

FIGURE A1. University Capital Stock and Teaching Staff, Canada 1919-20 to 1969-70

TABLE A-15

ESTIMATED[a] CUMULATIVE COST OF UNIVERSITY PLANT
CANADA 1920 - 21 TO 1968 - 69

Year	(Current Dollars) Thousands	(1961 Dollars) Thousands	Year	(Current Dollars) Thousands	(1961 Dollars) Thousands
1920-21	48,124	86,866	1944-45	97,454	165,457
22	52,784	104,730	46	102,627	164,995
23	56,461	108,998	47	112,409	163,623
24	59,765	117,880	48	123,248	159,648
25	61,665	124,074	49	139,779	174,506
26	65,708	133,825	50	150,178	180,937
27	68,158	137,415	1950-51	162,322	175,294
28	70,480	139,841	52	181,393	187,972
29	71,639	138,299	53	191,920	196,237
30	74,865	146,507	54	198,316	206,150
1930-31	82,403	170,961	55	221,837	229,170
32	89,017	195,213	56[b]	234,299	236,189
33	89,961	207,762	57	249,835	251,596
34	89,635	204,646	58	270,216	270,757
35	89,973	203,099	59	310,287	313,421
36	88,541	198,078	60	361,794	362,156
37	89,111	189,598	1960-61	430,429	430,429
38	90,867	194,994	62	509,591	508,067
39	91,342	197,710	63	594,599	582,940
40	94,644	197,175	64	707,086	691,189
1940-41	95,680	188,346	65	852,086	769,725
42	97,515	178,927	66	1,069,832	898,264
43	96,180	167,561	67	1,321,644	1,112,495
1943-44	97,006	166,106	68	1,630,427	1,367,808
			1968-69	1,988,548	1,583,239

TABLE A-15 (Continued)

Notes:

[a]See text for estimating procedure.

[b]From 1955-56 the source data changes from total value at cost to current additional expenditures, thus the series overstates cumulative cost of plant in place by the value (at cost) of dispositions after this date.

Sources:

1920-21 to 1945-46: Canada, Dominion Bureau of Statistics, Higher Education in Canada 1938-40 to 1944-46, Cat. No. 81-402 (Ottawa: Printer to the King's Most Excellent Majesty, 1941 to 1949).

1946-47 to 1953-54: Canada, Dominion Bureau of Statistics, Survey of Higher Education, 1946-48 to 1952-54, Cat. No. 81-402 (Ottawa: Queen's Printer and Controller of Stationery, 1950 to 1957).

1954-55 to 1961-62: Canada, Dominion Bureau of Statistics, Survey of Higher Education 1961-62 Cat. No. 81-211 (Ottawa: Queen's Printer and Controller of Stationery, 1964).

1962-63 to 1967-68: Canada, Dominion Bureau of Statistics, Canadian Universities, Income and Expenditures, 1961-62 and 1962-63, and 1963-64 to 1967-68 Cat. No. 81-212, (Ottawa: Information Canada, 1971). See also _____, Survey of Education Finance, 1954-56 to 1966, Cat. No. 81-208 (Ottawa: Queen's Printer, 1960 to 1970).

dollars.[44] There is a constant error in these data due to the assumption that the 1920-21 plant was all added in 1920-21. Since this was not the case, the deflator is inappropriate for that year's capital stock. The deflator is also inappropriate in years in which the current data declines since plant disposed of was not purchased in that year.

For the period 1954-55 to 1967-68 the incremental series was deflated to 1961 dollars and cumulated with the previous series. No allowance has been made for asset dispositions since 1954-55.

As estimates of capital stock these data suffer from severe difficulties. Capital stock data should ideally be given in constant efficiency units. Usually this requirement is met by assuming perfect competition in factor markets and counting capital in current prices. The data presented here are counted at cost of acquisition, not at replacement cost in the year concerned. Thus land is likely to be undervalued, and old buildings and equipment may be overvalued, especially in the latter half of the series where disposals are not removed. No depreciation has been applied, although some depreciated series were calculated. The net effect of these difficulties is not clear, except that there is an additional source of over-estimation after 1954-55.

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[44] Implicit price indexes for Business Non-Residential Construction in the category 'Building' were obtained from the Deflation Sector, National Income and Expenditure Division, Statistics Canada. Prior to 1926 weights of 0.417 for labour and 0.583 for material inputs were applied to construction wages and materials indexes from Urquhart and Buckley, Historical Statistics of Canada, Tables J68, D8.

For the period 1960-61 to 1967-68 Hettich derives capital stock data from unpublished questionnaire results from 49 universities. One series is based on reported book value, the other on insurance valuation. His procedures for deflation and collection obviously differ from those used for the present series.

Table A-16 presents Hettich's data in comparison to the cumulative cost of plant series derived above.

Hettich's book value series exceeds cumulative cost of plant by 6% ($24 M) in 1960-61 the difference rising to 23% ($313 M) in 1967-68. His insurance valuation estimates exceed the cumulative cost of plant estimates by 43% ($186 M) in 1960-61 and this difference was 35% ($481 M) in 1967-68. Bearing in mind the differences in institutions covered, cumulative cost of plant differs greatly from Hettich's capital stock series. It appears to be an underestimate, probably due to valuation changes.

Despite these drawbacks there are no alternative data for earlier years with which to examine the resource use of Canadian higher education.

Universities: Operating Income

Table A-17 presents the operating income of Canadian universities by source for selected years from 1920-21 to 1968-69.

Universities: Graduate Students to Staff Ratios

Table A-18 and Figure A-2 summarize available data on aggregate graduate student to staff ratios in Canada between 1919-20 and 1972-73. They show a general increase in this ratio of about 16 fold over the period. This increase has been accompanied in recent years by an increase in the ratio of

TABLE A-16

ALTERNATIVE ESTIMATES OF UNIVERSITY CAPITAL STOCK, CANADA, 1960-61 TO 1967-68

Year	Cumulative Cost of Plant	Hettich Estimates	
		Book Value	Insurance Valuation
	(Millions of 1961 Dollars)		
1960-61	430	454	616
1961-62	508	519	668
1962-63	583	601	756
1963-64	691	721	952
1964-65	770	925	1,160
1965-66	898	1,177	1,338
1966-67	1,112	1,389	1,567
1967-68	1,368	1,681	1,849

Sources: Table A-15 and Walter Hettich, Expenditures Output and Productivity in Canadian University Education, prepared for the Economic Council of Canada, Cat. No. EC 22-2/14 (Ottawa: Information Canada, 1971), p. 74-76.

TABLE A-17
DISTRIBUTION OF OPERATING INCOME OF UNIVERSITIES AND COLLEGES, BY SOURCE, CANADA, SELECTED YEARS, 1921-1969

Year[a]	Government[b]		Student Fees[c]		Other Sources[d]		Total	
	$ Mill	%	$ Mill	%	$ Mill	%	$ Mill	%
1920-21	4.5	50	1.8	20	2.7	30	9.1	100
1923-24	5.1	48	2.1	20	3.4	32	10.6	
1928-29	6.2	49	3.0	24	3.5	28	12.8	
1933-34	5.6	43	4.0	30	3.5	27	13.1	
1938-39	6.4	42	5.0	33	3.8	25	15.2	
1943-44	7.7	42	5.5	30	5.0	28	18.2	
1948-49	16.2	41	16.0	40	7.4	19	39.6	
1951-52	25.8	53	14.6	30	8.5	17	48.9	
1954-55	44.8	57	21.3	27	12.7	16	78.8	
1959-60	89.0	60	40.8	27	19.2	13	149.0	
1964-65	200.4	58	89.7	26	52.6	15	342.8	
1966-67	384.5	66	130.0	22	67.1	12	581.6	
1967-68	521.1	70	144.5	20	75.0	10	740.6	
1968-69	646.2	72	162.1	18	88.5	10	896.9	

[a] Coverage of institutions is not universal. Up to and including 1951-52 the larger universities and many of the colleges of Canada are covered. After that time estimates of the revenues of non-reporting institutions are included. Non-reporting institutions account for 10 - 20% of total enrolment in the 1950's. For the years 1921 to 1949 data are published in the source under the year of the spring term, i.e., 1920-21 data are published under 1921.

[b] Includes federal, provincial and municipal sources.

TABLE A-17: continued

[c] Excludes residence fees.

[d] Includes endowment. Excludes residences and other ancillary enterprises after 1954-55.

Sources: Canada, Dominion Bureau of Statistics, Higher Education in Canada, 1938-40; 1942-44 (Ottawa: Printer to the King's Most Excellent Majesty, 1941; 1946).

_____, Survey of Higher Education, 1948-50 (Ottawa: Queen's Printer and Controller of Stationery, 1952).

_____, Preliminary Statistics of Education, 1951-1952 (Ottawa: Queen's Printer and Controller of Stationery, 1954).

_____, Canadian Universities Income and Expenditure, 1967-68, Cat. No. 81-212 (Ottawa: Information Canada, 1971).

_____, Preliminary Statistics of Education, 1969-70, Cat. No. 81-201 (Ottawa: Information Canada, 1971).

TABLE A-18
GRADUATE ENROLMENT AND TEACHING STAFF
IN CANADIAN UNIVERSITIES,
1919-20 TO 1972-73

Year	Graduate Student to Staff Ratio	Assistant Professor Salary to Manufact. Wages	Year	Graduate Student to Staff Ratio	Assistant Professor Salary to Manufact. Wages	Assistant Professor Salary to Graduate Stipend
1919-20	0.128		1946-47	0.643	100.43	
21	0.127		48	0.657	96.72	
22	0.178		49	0.822	90.02	
23	0.202					
24	0.247		1949-50	0.882	86.08	
25[a]	0.386		51	0.802	87.05	
26	0.329		52	0.693	88.84	
27	0.275		53	0.680	82.00	
28	0.323		54	0.686	83.09	
29[b]	0.353		55[d]	0.750	84.00	
			56	0.746		
1929-30	0.322		57	0.732	83.01	4.894
31	0.369		58	0.780	89.82	
32	0.394		59	0.795	99.81	
33	0.415					
34	0.409		1959-60	0.831	101.44	
35	0.365		61[d]	1.039	103.11	
36[c]	0.521		62	1.088	103.25	5.291
37	0.512		63[e]	1.301	101.34	
38	0.458		64	1.442	100.64	
39	0.454		65	1.579	101.13	
			66	1.650	102.96	5.886[g]
1939-40	0.460		67	1.639	105.06	
41	0.416		68	1.693	108.56	6.154
42	0.374		69	1.558	106.52	6.060
43	0.320		1969-70	1.839	106.96	
44	0.347		71[f]	1.927		
45	0.421		72	1.961		
1945-46	0.561	98.23	1972-73	2.015		

TABLE A-18: continued

[a, b, c, d] From this year there was a change in teaching staff data.

[e] Enrolments data changed definitions in this year.

[f] Data are preliminary estimates for 1970-71 onwards.

[g] Refers to the period 1965-67.

Sources: Tables 1.1, A-1, A-14, B-10.

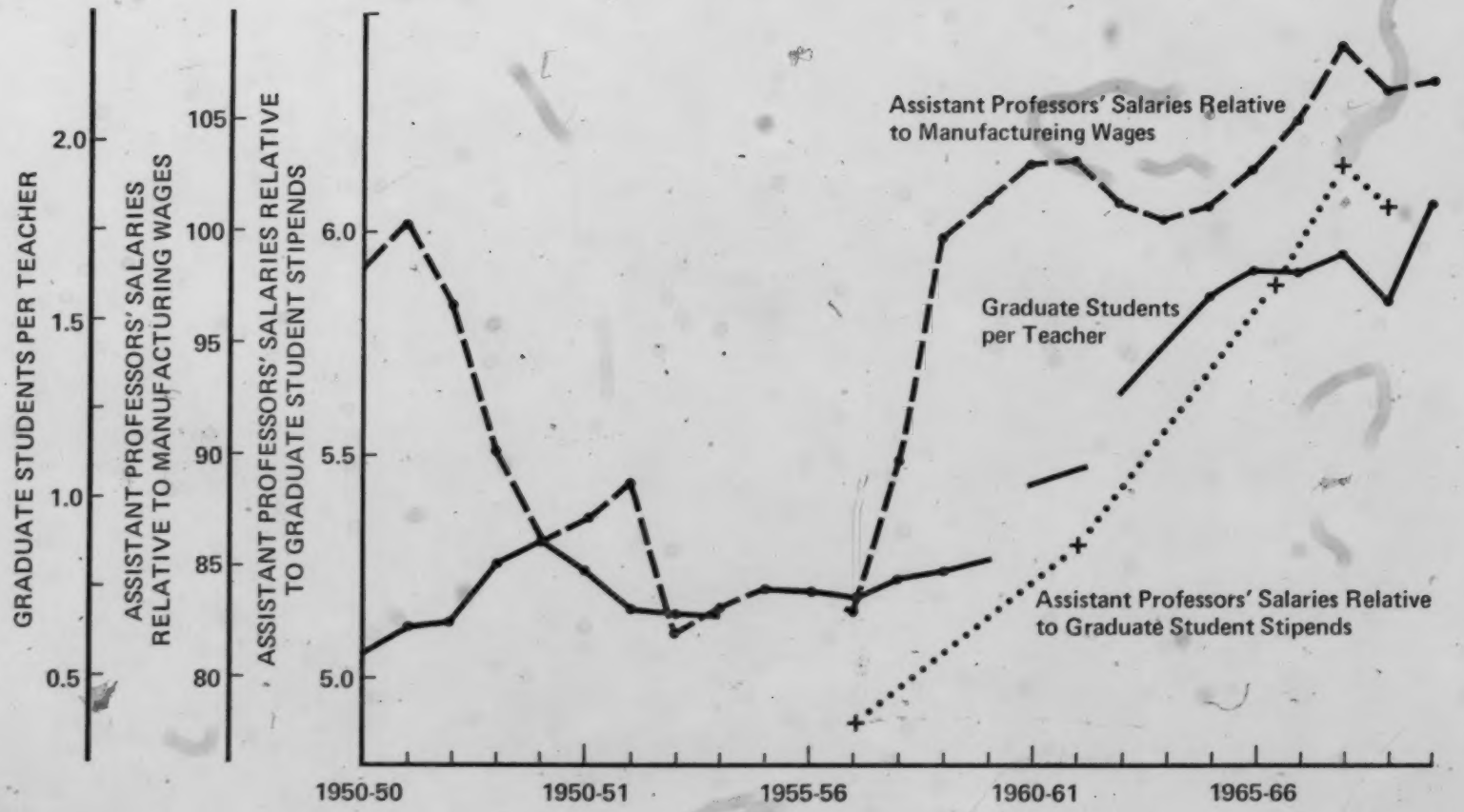

FIGURE A2. Relative Salaries and the Ratio of Graduate Enrolment to Teaching Staff, Canadian Universities, 1945-46 to 1969-70

teaching staff salaries to graduate student stipends, and of the ratio of teaching staff salaries to manufacturing wages.

It is striking that the year to year changes in the relative salaries of assistant professors and in the graduate student to staff ratio begin to be consistent between 1951-52 and 1952-53. The reader will recall that federal government operating grants to universities begin in 1951-52. These data are consistent with a constraint on staff-student ratios until about 1951-52. Following that time changed formula grants for graduate enrolment and increased activities of graduate student support agencies, external to the universities, lowered the costs borne by universities in supporting graduate students relative to those associated with teaching staff.

The early constraint on staff student-ratios may have been simply a matter of budgets too small to allow Canadian universities to make their optimal choices of the proportion of teaching staff to graduate enrolment.

These aggregate data are not directly appropriate to the behaviour of individual universities without very strong assumptions being made. They should be considered illustrative only. Data from an individual institution were not collected.

APPENDIX B

EXPLICIT OPPORTUNITY COSTS AND INCOME PECULIAR TO STUDENTS

In deciding which incomes and which expenditures to include the following identities were constructed to act as a guide.

(1) Foregone income = foregone consumption + foregone saving = highest alternative income - actual income available

(2) Explicit opportunity costs = expenditures not otherwise made.

Thus income available only to students reduces opportunity cost by reducing foregone income.[1] Funds and gifts from parents and relatives, loans and dissaving from accumulated wealth were therefore omitted.[2] Several other sources of income were omitted due to the difficulty of deciding whether they were sources unique to the educational situation. These sources include spouse's income.

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[1] See Schultz, Investment in Human Capital, p. 115, for a discussion of the effects on computed rates of return of graduate stipends.

[2] Some researchers have noted that the foregone interest earnings on savings used up should also be counted as foregone income, and similarly, extra future earnings from extra future savings should be considered a yield. This has not been attempted. See Wilkinson, Studies in the Economics of Education, p. 12.

Tables B-1 to B-14 below present the available data and the calculations made using them. They are presented in detail so that the reader will realize that these estimates are most unreliable.

Data are available on student incomes for the years 1956-57, 1961-62, 1965-67, 1967-68 and 1968-69.

For the year 1956-57, available data for graduate students include incomes distributed by source, median incomes, total expenditure distributed by item and median expenditure.[3] Examination of the incomes data revealed that 69.4% of income could be classified as available only to students and this percentage was applied to median income in order to provide an estimate of graduate student income in that year.[4] Examination of expenditure data revealed that 16.9% of total expenditure was made on items which were related to education and would not have been made otherwise.

These calculations resulted in estimates of (69.4% x 1724 = 1204) $1200 per annum for student income and (16.9% x 1649 = 279) $279 per annum for explicit opportunity costs of the graduate student in Canada in 1956-57.

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[3] These data are presented in Tables B-1 and B-2 below. The source for 1956-57 data is: Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1956-57, Cat. No. 81-509 (Ottawa: Queen's Printer and Controller of Stationery, 1959), pp. 51, 77, 39, 76.

[4] Since income distributions are often skewed the median may be the most appropriate income statistic for use in this fashion.

Tables B-3, B-4, B-5, B-6, and B-7 present available data and computations for 1961-62.[5] They include the percentage distribution of graduate student expenditure by item, place of residence, sex, and marital status. Dollar expenditures are available by place of residence, sex, and marital status. A numerical distribution of graduate students by place of residence, sex and marital status is computed and used to calculate overall proportions for these data. Sample data for total graduate student income by place of residence and marital status is used to compute an estimate of average graduate student income. This estimate is then combined with data about fellowship and part-time incomes and median summer savings, to estimate the proportion of income derived from those sources. This proportion was used to estimate income from sources available only to the student.

These calculations resulted in estimates of (17.5% x 2468) = $433 for median explicit opportunity cost of graduate students and (56.5% x 2887) = $1630 for estimated income from sources only available to a student in 1961-62.

For the year 1968-69, data are available on median incomes of graduate students by source and level of degree sought. Also available are data on median expenditures of graduate students, by type and level of graduate degree

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[5] These data are drawn from Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1961-62: Part III, Canadian Graduate Students, Cat. No. 81-521 (Ottawa: Queen's Printer and Controller of Stationery, 1964) Table 36, p. 32; Table 35, p. 31; Table 1, p. 13; Table 4, p.14; Table 39, p. 34; Table 43, p. 36; Table 46, p. 37; Table 49, p. 39; Table 30, p. 28.

sought.[6] Examination of Tables B-8 and B-9 reveals that the categories used in these two classifications combine items, which represent costs or incomes of students with items which would occur whether or not the individual was a graduate student. This problem was resolved by an arbitrary procedure.

To estimate graduate student explicit opportunity costs, the item 'tuition and other fees paid' ($592) might be selected, or it might be arbitrarily assumed that the percentage of total expenditure, which was avoidable by not entering graduate studies, was the same in 1968-69 as it was in 1961-62, (i.e., 17.5% x 2824 = $494). Since expenditures data on fees include insurance and health fees, they overstate explicit opportunity costs. On the other hand, the item does not include additional transportation expenses incurred by being a student, or the cost of textbooks and student supplies, and may therefore understate explicit opportunity costs. The two previous estimates of the percentage of expenditure which is explicit opportunity cost are remarkably close (16.9% in 1956-57 and 17.5% in 1961-62), lending some support to the assumption of constancy. The fees estimate ($592) represents 21% of expenditures in 1968-69.

There is not enough evidence to indicate which choice is the most accurate. The lower, constant proportion of expenditures estimate was chosen,

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[6] Both these data items are drawn from William H. Lucow "Statistics derived from the original tables for Canada as a whole: Q1, median, Q3 and the range of the middle half of each distribution in the . . . Post-Secondary Student Population Survey, 1968-69," unpublished mimeo (Education Division, Dominion Bureau of Statistics, April, 1970). See also the source notes for Tables B-8 and B-9.

estimating explicit opportunity costs in 1968-69 as $494.

Estimation of the income available only to students, in 1968-69 faces similar confusion between categories. The choice is between 'total personal income', which combines spouses income and gifts from relatives with part-time earnings and savings from summer work, and an estimate of 56.6 percent of 'total income', 56.6 percent being the proportion of income appropriate for 1961-62. (In 1956-57 the percentage of total income not otherwise available was estimated to be 69.4%.) 'Total Personal Income' is given as $1422 in 1968-69 while the 'constant proportion of total income' estimate is (56.6% x 3742 = 2118) $2120. Total Personal Income is 38% of Total Income in 1968-69.

Here again, without sufficient evidence to distinguish these estimates, the constant proportions estimate was chosen. Accordingly, student income not otherwise available was estimated to be $2120 in 1968-69.

Two further sources on graduate student incomes were consulted.[7] The compilation by the Canadian Association of Graduate Schools of biennial data on graduate student income is not sufficiently detailed to provide information on expenditures, and provides only data on stipend incomes of students. Since these stipend incomes contribute a large part of the income which students obtain, and which is available only to students, they have been included in Table B-10.

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[7] Canadian Association of Graduate Schools, Statistical Report October 1969, compiled by R. W. Martin with comments by J. B. Hyne and R. W. Martin (Calgary: Faculty of Graduate Studies, University of Calgary, 1969) and J. B. Hyne, "Report to the Canadian Association of Graduate Schools on Graduate Student Financial Support, 1965-67" (unpublished report, August, 1967).

Table B-10 summarizes the estimates of graduate student income and of graduate student explicit opportunity costs which are relevant to human capital decisions by graduate students, and which have been estimated as discussed above.

These estimated explicit opportunity costs do not include reductions in living expenses because foregone income already includes this cost. For 1956-57, all living costs (room rent, board, snacks, etc. recreation, health, clothing, laundry), transportation from living quarters to college, all other transportation from living quarters to college, all other transportation, church, other expenses not related to college attendance and capital costs were omitted from estimated explicit opportunity cost. Transportation from hometown to college, was included. This results in estimates of explicit opportunity costs as $279 in 1956-57, and as $433 in 1961-62.[8] For 1968-69, an estimate of 17.5% of median total expenditure is used. The result is $494.[9] These estimates are shown in Table B-10.

These estimates indicate that the money difference between student income not otherwise available and student costs not otherwise incurred has been positive for the whole period and has been increasing. This suggests that during this time, even if foregone incomes and future incomes had remained constant,

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[8] Note that 1956-57 expenditure data does not include the value of fees remitted. See Table B-2 above. The 1961-62 data are from Table B-3, note b.

[9] See Table B-9 and the text related to Table B-3, where it is pointed out that in 1961-62 the estimate of explicit opportunity cost for students was 17.5 percent of median total expenditure. See also Table B-10, note d.

the private inducement to invest in graduate education increased.[10]

Although the evidence is by no means conclusive, based as it is on a very poor set of data, they suggest that, in Canada, graduate students do receive in student incomes, not otherwise available, more than they incur as direct financial costs by choosing to be graduate students. This is also supported by casual observation. The support levels provided graduate student teaching assistants, research assistants and scholarship holders appear geared to the living expenses of the student. By far the larger part of living expenses are incurred as a result of living, not as a result of a choice to enter graduate studies. It should be borne in mind that the graduate student is often required to perform some duties for his income and will incur some psychic costs therefore; on-the-other hand many non-students work for income longer hours than do graduate students. The direct out-of-pocket costs peculiar to students are relatively small and often are defrayed further by such practices as the waiver of fees and granting of travel expenses.

It was also possible to derive, from the same sources, some information regarding student incomes and costs by level of graduate study and by subject grouping. These data are valuable because of the light they throw on the relative desirability, from a human capital investment viewpoint, of investment in

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[10] Note also that student incomes of graduate students are subject to much less discounting than foregone and future incomes, so that present values are more sensitive to changes in them than to changes in yields, of the same dollar value, in future periods.

master's degree level versus doctorate training or of investment in sciences graduate training versus the humanities.

Table B-11 presents for 1968-69 the total of scholarship, fellowship and assistantship awards from all sources (including remission of fees) granted to graduate students in Canada apart from Quebec, by broad faculty affiliation. A comparison of faculties by percentage of the average award per full-time graduate student, shows that graduate students in the physical and biological sciences have received, respectively, 23% and 15% higher than average support while those in humanities and social sciences have received, respectively, 19% and 32% less than average support. When expressed as a percentage of the average award per supported student, students in the physical and biological sciences received 11% and 4% more per award, respectively, than the average while those in the humanities and social sciences received 8% and 13% less, respectively. In short, students have received more money from these student income sources per student, and a larger proportion of eligible students have been supported, if they were enrolled, in the sciences than if they were enrolled in the humanities or social sciences.

Only scattered information is available on the variation of student costs and student incomes by level of degree sought. This material was presented in Tables B-8 and B-9 above. Table B-12 below is derived from these data and information on numbers of students in the categories discussed.

Two sets of proportions are calculated, differing in the base of comparison. The alternative bases are: The numerically weighted average (cost

or income) computed for all graduate students reported, and the numerically weighted average (cost or income) computed for only the master's degree and doctoral degree students. Both bases were calculated in an attempt to derive proportions which would provide estimates in other years in association with enrolment data for those years. Unfortunately enrolment data are not detailed enough to examine the conditions required for these estimates to be accurate.

Most complete data are available for 1968-69. Table B-13 presents for 1968-69 estimates of the difference between student incomes and student costs by level of degree and by faculty of study. These estimates are made by assuming that proportions of overall averages from the above estimates are constant across the groups considered.

The construction of Table B-13 has assumed that student costs do not vary by subject. Also the relationship between master's and doctorate students' income is assumed to be constant in each subject and to vary between faculties in the same proportions as do award incomes.

The calculations reported in Table B-13 indicate that, if the assumptions upon which they are based are valid, then private human capital calculations will favour science over non-science students, and doctorate over master's degree students, other things being equal. The data are not adequate to support conclusions regarding support policies but do suggest that further investigation of this area is warranted. Such biases in support policies may be seriously distorting the subject distribution and degree distribution among higher degree graduates in Canada.

New data, collected by the Council of Ontario Universities for 1972-73 have now been published and are discussed in the text.[11]

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[11] Council of Ontario Universities, Graduate Student Incomes in Ontario, 1972-73, (Toronto: Council of Ontario Universities, 1974) mimeo.

TABLE B-1

INCOME OF GRADUATE STUDENTS BY SOURCE, CANADA, 1956-1957

Source	Percentages of total income
Sources available only to students	
Scholarships, prizes	14.6
Bursaries	3.3
Department of Veterans Affairs	0.8
National Defence, R.O.T.P., etc.	1.0
Leave of absence with pay (or part pay)	2.0
Other grants in aid	8.8
Net savings from summer jobs	15.3
Savings from part-time jobs during school year	23.6
Total of sources available only to students	69.4
Sources available to non-students	
Loans	4.6
Funds and gifts from friends and relatives	7.1
Use of savings accumulated prior to summer 1956	5.2
Amount used from money investments, trust funds, endowments, insurance policies, etc.	4.1
Other sources (includes spouse's income)	9.6
Total of sources available to non-students	30.6
Total	100.0

Source:

Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1956-57, Cat. No, 81-509 (Ottawa: Queen's Printer and Controller of Stationery, 1959). Table 58, p. 51.

TABLE B-2

EXPENDITURE OF GRADUATE STUDENTS BY ITEM, CANADA, 1956-1957

Item	Percentages of Total Expenditure
Expenditure made only by students	
Fees (tuition, etc.)	11.2
Books and supplies	2.5
Transportation from home town	2.2
Other current expenses related to attendance	1.0
Total of expenditure of students	16.9
Expenditure not restricted to students	
Room rent for school year	17.7
Board: regular meals for school year	18.0
Fraternity or sorority dues	0.2
Snacks, refreshments, cigarettes, etc.	3.3
Recreation and entertainment	4.9
Health	3.4
Grooming etc.	1.1
Clothing (including footwear)	6.6
Laundry and drycleaning	1.2
Transportation from living quarters to college	1.4
Other transportation	1.7
Church and charitable donations	1.4
Other current expenses not related to attendance	14.0
Capital costs	8.2
Total expenditure not restricted to students	83.1
Total	100.0

Source:

Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1956-57, (Ottawa: Queen's Printer and Controller of Stationery, 1959) Table 45, p. 39.

TABLE B-3
EXPENDITURE OF GRADUATE STUDENTS[a] BY ITEM, AND NUMBER OF GRADUATE STUDENTS BY MARITAL STATUS, LIVING ARRANGEMENTS AND SEX, CANADA, 1961-1962

Item	Single				Married
	At Home		Away		With Spouse
	Male	Female	Male	Female	
	Percentage of Total Expenditure				
Expenditures made only by students					
Fees (tuition, etc.)	21.2	22.4	16.2	17.2	8.0
Textbooks	4.3	4.4	3.5	3.0	1.7
School supplies & equipment	1.3	1.2	1.1	1.1	0.7
Transportation from home	2.0	1.5	3.7	4.2	1.2
Total Student expenditure	28.8	29.5	24.5	25.5	11.6
Expenditures made also by non-students					
Dues (fraternity, etc.)	0.7	0.6	0.5	0.3	0.2
Transportation (local)	4.5	3.7	1.8	1.7	2.0
Rec'n., refreshments, cigarettes, etc.	15.0	7.6	10.5	6.3	4.8
Grooming	2.6	4.3	3.0	3.6	2.2
Clothing	8.5	14.1	5.7	8.8	4.6
Health	3.4	5.3	2.3	3.3	3.5
Durable items	11.2	7.1	7.7	3.0	9.7
Room & board, household op'ns.	16.9	20.6	37.4	39.9	52.0
Church & charitable	1.2	1.5	0.8	1.5	1.4
Other	7.2	5.7	5.8	6.1	8.0
Total non-student expenditure	71.2	70.5	75.5	74.5	88.4
Total	100.0	100.0	100.0	100.0	100.0
	Number of Graduate Students[d]				
Number	1210	377	2309	512	2939

TABLE B-3: continued

Item	Single				Married
	At Home		Away		With Spouse
	Male	Female	Male	Female	
	Dollar Expenditures				
Median total expenditure[c]	1426	1258	1893	1861	3610
Estimated student expenditure[b]	411	371	464	475	419

[a]While the source publication deals only with graduate students, the particular table from which these data are drawn does not specify graduate students.

[b]Estimated by multiplying median total expenditure by the percentage of total expenditure made up of expenditures made only by students. By weighting these dollar values by the corresponding numbers of students, summing and dividing by the total number of students (7347), an estimate of $433 is obtained of the overall average expenditure made only by students.

[c]An estimate of $2468 is obtained of total expenditure by taking the weighted average of these figures, using the numbers of students as weights.

[d]These numbers were estimated from data in Tables 3.1 and 3.4 source as follows: Of the total number 7347 (= 377 + 512 + 1210 + 2309 + 2939), 6142 were male and 1205 female.

Of the females, 31.3 percent (377) were single and living at home, and 42.5 percent (512) were single and living away from home. Of the males, 19.7 percent (1210) were single and living at home while 37.6 percent (2309) were single and living away from home. Forty percent of all Canadian graduate students (2939) were married.

Sources: Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1961-62: Part III, Canadian Graduate Students, Cat. No. 81-521 (Ottawa: Queen's Printer and Controller of Stationery, 1964), Table 36, p. 32 and Table 35, p. 31.

TABLE B-4

ESTIMATED[a] GRADUATE STUDENT INCOME FROM ALL SOURCES BY MARITAL STATUS AND LIVING ARRANGEMENTS, CANADA, 1961-1962

Item	Single		Married	All Students
	At Home	Away		
Sample values				
Income (dollars/student)	1920	2233	4026	2887
Numbers of individuals	726	1962	1690[b]	4378
Income accounted for ($)	1393920	4381146	6864780	12639846
Students in population	1587	2821	2939	7347

[a]These data are drawn from sample survey results published in the source.

[b]Excludes 63 "others" most of whom are religion students. The sample contained a total of 4441 students (i.e. 4378+63).

Source:

Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1961-62: Part III, Canadian Graduate Students, Cat. No. 81-521 (Ottawa: Queen's Printer and Controller of Stationery, 1964). For income data: Table 39, p. 34; for population data: Table 1, p. 13 and Table 4, p. 14; for sample size data: Table 43, p. 36.

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TABLE B-5
ESTIMATED[a] GRADUATE STUDENT INCOME
FROM FELLOWSHIP SOURCES BY CITIZENSHIP, CANADA,
1961-1962

Item	Canadian	Non-Canadian	All
Sample Values			
Average value of fellowship ($)	1,665	1,748	1,683
Number in sample	3,426	1,015	4,441
Recipients in sample (%)	54	54	54
Recipients in sample (number)	1,850	548	2,398
Total value of fellowships[b] ($)	3,080,250	957,904	4,038,154

[a]These data are drawn from sample survey results published in the source.

[b]Calculated as (average value of fellowship) x (number of recipients in the sample). Note that these numbers have at most 3 significant figures.

Sources: Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1961-62: Part III, Canadian Graduate Students, Cat. No. 81-521 (Ottawa: Queen's Printer and Controller of Stationery, 1964). For fellowship values: Table 46, p. 37; for sample size data: Table 43, p. 36.

TABLE 6

ESTIMATED[a] GRADUATE STUDENT EARNINGS FROM PART-TIME EMPLOYMENT BY CITIZENSHIP AND MARITAL STATUS, CANADA, 1961-1962.

Item	Canadian		Non-Canadian		All
	Single	Married[b]	Single	Married[b]	
Sample values					
Average earnings ($) . .	881	2,313	614	482	1,377
Number in sample . . .	2,016	1,347	672	343	4,378
% reporting income . . .	18.4	20.4	8.8	9.0	16.8
No. reporting income[c]	371	275	59	31	736
Total income[cd]	326,851	636,075	36,226	14,942	1,014,094

[a]These data are drawn from sample survey results published in the source.

[b]Includes other categories such as religion students.

[c]These results have at most 3 significant figures.

[d]Calculated as (average earnings) x (number reporting income) except for the figure in the All column, which is the sum of the other elements in the row. Calculated as a product this figure is $1,013,472, or a difference of $622.

Source: Canada, Dominion Bureau of Statistics, University Student Expenditure and Income in Canada, 1961-1962: Part III, Canadian Graduate Students., Cat. No. 81-521, (Ottawa: Queen's Printer and Controller of Stationery, 1964) Table 43, p. 36 and Table 49, p. 39.

TABLE B-7

ESTIMATED GRADUATE STUDENT INCOME FROM SOURCES AVAILABLE ONLY TO STUDENTS, CANADA, 1961-1962

	Average	Total	Percent of Total
Income from all sources . .	$2887	$12639846	100.0
Income from fellowships . .	1683	4038154	31.9
Income from part-time earnings	1377	1014094	8.0
Savings from summer earnings[a]	476	2113916	16.7
Income from fellowship, part & summer			56.6
Estimated income from sources available only to students ($2887)x(56.6))	1634[b]		

[a]Calculated as (($476)x(4441)), where 4441 is the number of students in the sample.

[b]Since not all students in the sample would have had incomes in these categories the average from these sources can be, and is, lower than the average income from one of these sources.

Source:

Dominion Bureau of Statistics: University Student Expenditure and Income in Canada, 1961-62: Part III, Canadian Graduate Students, Cat. No. 81-521 (Ottawa: Queen's Printer and Controller of Stationery, 1964), Table 30, p. 28.

TABLE B8

MEDIAN GRADUATE STUDENT INCOME BY SOURCE AND LEVEL OF DEGREE, CANADA, 1968-1969

Source	All Grad	Masters	Ph.D.	Other Grad.
Stipend income	n.a.	$2263	$3514	$861
Parents total contribution	n.a.	452	435	511
Total personal revenue[a] .	1422	1258	2307	844
Reduction of assets . . .	699	692	554	884
Addition to liabilities .	n.a.	780	536	948
Total income[b]	3742	n.a.	n.a.	n.a.

[a]Includes part-time earnings and summer savings with spouses income and cash gifts from relatives. On the basis of 1956-57 data, given in Table B1 above, 78.8 percent of this item consists of sources available only to students.

[b]Since the data reported are medians, summation gives meaningless results, and has not been attempted.

n.a.: Data not available.

Source: Dominion Bureau of Statistics, Post-Secondary Student Population Survey, 1968-69, Cat. No. 81-543, (Ottawa: The Queen's Printer, 1970) and William H. Lucow, "Statistics derived from the original tables for Canada as a whole: Q_1, median, Q_3 and the middle half of each distribution in the . . . Post-Secondary Student Population Survey, 1968-69," unpublished mimeo, (Education Division, Dominion Bureau of Statistics, April, 1970), Tables 19, 20, 21, 22, 23, 24, 26, 28.

TABLE B-9

MEDIAN GRADUATE STUDENT EXPENDITURE BY ITEM AND LEVEL OF DEGREE, CANADA, 1968-69

Item	All Grad.	Masters	Ph.D.	Other Grad.
Tuition and other fees paid[a]	$592	$442	$483	$408
Other academic expenses	n.a.	168	181	156
Total personal expenses[b]	n.a.	2070	3224	1272
Expenditure by addition to assets	945	787	933	410
Housing food and beverages	1362	n.a.	n.a.	n.a.
Transportation	182	n.a.	n.a.	n.a.
Residual personal expenses[c]	887	n.a.	n.a.	n.a.
Expenditure by reduction in liabilities	n.a.	492	612	448
Total expenditure	2824	n.a.	n.a.	n.a.

TABLE B-9 (Continued)

[a]Other fees include health and insurance fees.

[b]Includes transportation.

[c]Excludes tuition and other fees and room and board.

Source: Dominion Bureau of Statistics, Post-Secondary Student Population Survey, 1968-69, Cat. No. 81-543 (Ottawa: The Queen's Printer, 1970), and William H. Lucow, "Statistics derived from the original tables for Canada as a whole: Q_1 median, Q_3 and the middle half of each distribution in the . . . Post-Secondary Student Population Survey, 1968-69," unpublished mimeo, (Education Division, Dominion Bureau of Statistics, April, 1970), Tables 1, 4, 5, 6, 7, 8, 10, 12, 14, 16, 17.

TABLE B-10

ESTIMATED EXPLICIT OPPORTUNITY COSTS[a] AND ESTIMATED INCOME AVAILABLE ONLY TO GRADUATE STUDENTS[b], CANADA SELECTED YEARS, 1956-57 TO 1968-69

Item	1956-57	61-62	65-67	67-68	68-69
Income available only to graduate students	$1204	$1634	$1820[c]	$1960[c]	$2120
Explicit opportunity cost	279	433	n.a.	n.a.	494[d]
Difference[e]	+925	+1201	n.a.		+1626

[a]Explicit opportunity costs exclude foregone income (an implicit cost) and normal living costs (not opportunity costs of students). It is intended to include items of out-of-pocket cost which only graduate students incur.

[b]This category includes only sources of income which would not be available were the individual to undertake some activity other than graduate study. In particular it includes remissions of fees.

[c]Income may have been higher than estimated in these years due to the prevalence of fee remissions for graduate students. Fee remissions were not included in data for these years. Canadian Association of Graduate Schools data.

[d]Estimated as 17.5 percent of median total expenditure ($2824 x .175 = 494).

[e]Income less cost.

Source: Tables B-1 to B-9 above and Canadian Association of Graduate Schools, Statistical Report, October 1969, compiled by R. W. Martin with comments by J. B. Hyne and R. W. Martin (Calgary: Faculty of Graduate Studies, University of Calgary, 1969), and J. B. Hyne, "Report to the Canadian Association of Graduate Schools on Graduate Student Financial Support, 1965-67" (unpublished report, August, 1967).

TABLE B-11

VALUE OF AWARDS FROM ALL SOURCES TO GRADUATE STUDENTS BY FACULTY, CANADA OUTSIDE QUEBEC, 1968-69

Item	Faculty				
	Humanities[a]	Social Science[b]	Physical Science[c]	Biological Science[d]	Total
Total Awards	$7526265	$10324009	$19988268	$7284299	$45122841
No. of Recipients	2692	3887	5989	2320	14888
Award per Recipient . . .	$2796	$2656	$3338	$3140	$3031
Percent of Average Award Per Recipient	92.4%	87.4%	111.0%	103.7%	100.0%
Full Time Grad. Enrolment .	3318	5709	6286	2510	17823
Percent F.T. Supported . .	81.1%	68.1%	95.3%	92.4%	83.5%
Award per F.T. Student . .	$2268	$1808	$3108	$2902	$2532
% of Average Award per F.T. Student	89.6%	71.4%	122.8%	114.7%	100.0%

[a]Asian and slavic studies, classics and latin, english language and literature, french language and literature, linguistics, modern languages and literature, medieval studies, fine arts (art, music, drama), history, philosophy, theology and religion.

TABLE B-11 (Continued)

[b]Archeology, anthropology, economics, geography, meteorology and climatology, political science, psychology, sociology, architecture, urban planning, business, public administration, law, social welfare, education, industrial vocational education, library science, physical education.

[c]Astronomy, chemistry, geology, mathematics, physics, biology, engineering: chemical, civil, electrical, industrial, mechanical; mining and metallurgy, materials science, and engineering design, aerospace sciences, computer science.

[d]Biochemistry, biophysics, botany, entomology, genetics, zoology, anatomy, biomedical engineering, cancer research, clinical science, dentistry, hospital administration, medicine, microbiology and immunology, nursing, pathology, pharmacy, pharmacology, physiology, psychiatry, public health hygiene, surgery, agriculture, animal science, food science, plant science, soil science, veterinary medicine, forestry, marine science.

Source: Canadian Association Graduate Schools, Statistical Report, October, 1969. See Table B-10 above for full citation.

TABLE B-12

EXPLICIT OPPORTUNITY COSTS, INCOMES AVAILABLE ONLY TO STUDENTS, AND COMPUTED RATIOS TO AVERAGES OF ALL GRADUATE STUDENTS AND OF ALL MASTERS AND DOCTORAL STUDENTS, CANADA, 1968-69

	Masters	Doctoral	Masters & Doctoral	Other Grad.	All Grad.
Explicit opportunity costs . . .	$442	$483	n.a.	$408	n.a.
Number of students	15,445	9,020	24,465	4,686	29,151
Weighted average cost	-	-	$457	-	$449
Income available only to students	$2,263	$3,154	n.a.	$861	n.a.
Weighted average income	-	-	$2,591	-	$2,313
			Ratios		
Ratio to 'All Grad.' average					
Explicit opportunity cost . . .	0.98	1.08	1.02	0.91	1.00
Income available only to students	0.98	1.36	1.12	0.37	1.00
Ratio to 'Masters & Doctoral'					
Explicit opportunity cost . . .	0.97	1.06	1.00	0.89	0.98
Income available only to students	0.87	1.22	1.00	0.33	0.89

Sources: Table B-9 and B-10 above, and the source cited for Table B-9. See Table 21, p. 121 of the published source noted there.

TABLE B-13

ESTIMATED[a] INCOMES AVAILABLE ONLY TO GRADUATE STUDENTS NET OF EXPLICIT OPPORTUNITY COSTS, BY LEVEL OF DEGREE AND SUBJECT, CANADA, 1968-69

Level	All Subjects	Humanities	Social Science	Physical Sciences	Biological Sciences
All levels	$1,600	$1,400	$1,000	$2,100	$1,900
Masters	1,600	1,400	1,000	2,100	1,900
Doctoral	2,400	2,100	1,500	3,000	2,800

[a]Estimation procedure was as follows: Income for all subjects and all levels was estimated above as $2,120 (Table B-10). From Table B-11, students in humanities, social science, physical sciences, and biological sciences received, respectively, 0.90, 0.71, 1.23, and 1.15, of the average award income of all graduate students. Similiarly, cost for all subjects and all levels was estimated above as $494 (Table B-10). Cost was not distributed across subjects. The distribution of costs and incomes between levels was done using the ratios for 'All Grad.' calculated in Table B-12 above. For each level of degree, cost was subtracted from the varying estimate of income. Thus the whole of this table is derived by applying ratios estimated previously to the estimates; $2,120 for income, and; $494 for cost. For this reason, as stressed in the text, no reliance should be placed on thest estimates.

Source: Tables B-10, B-11 and B-12 above.